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CENTRAL FLORIDA PHOSPHATE INDUSTRY AREAWIDE IMPACT ASSESSMENT PROGRAM

Volume IV: Atmosphere

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In this volume of a 7-volume environmental impact assessment of the phosphate industry in central Florida, a description of the climate and dispersion characteristics in Hillsborough, Polk, Manatee, Hardee, Sarasota, DeSoto, and Charlotte counties sets the stage for a discussion of the areawide air quality. Air pollution sources are listed and 5 years of sulfur dioxide and particulate data summarized.

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FOREWORD

This is one in a series of reports presenting information developed by, or supplied to, Texas Instruments Incorporated (TI) while conducting an areawide environmental impact assessment of the central Florida phosphate industry for the Environmental Protection Agency (EPA). Because of the diversity and number of groups and individuals interested in this program, the EPA and TI encouraged active public involvement by making working papers available for review and comment as they were developed through environmental analysis, impact assessment, and alternative selection. These working papers then were prepared as a series of reports incorporating the original material modified through the incorporation of comments and additional information developed by TI. Other reports in the series include:

Volume	Title
I	Program and Industry Description
II	Laws and Regulations
III	Socioeconomics
V	Water
VI	Land
VII	Impacts of Alternative Public Policies on Social, Economic, and Natural Environmental Systems

These reports are made available through the National Technical Information Service to serve as background information to the environmental statements (draft and final) and environmental planning needs of federal, state and local agencies as well as other interested parties. The information will be of value to those involved with development and regulation of the phosphate industries, others who plan developments in central Florida, and enviornmental planners in general who must deal with environmental issues on a regional basis. It is hoped their use will lead to good decisions. It has often been said that decisions are only as good as the information on which they are based. Extending that philosophy, decisions are only as good as the decision makers' understanding of the adequacy of the information in resolving the issues being examined.

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SECTION 1

CLIMATE

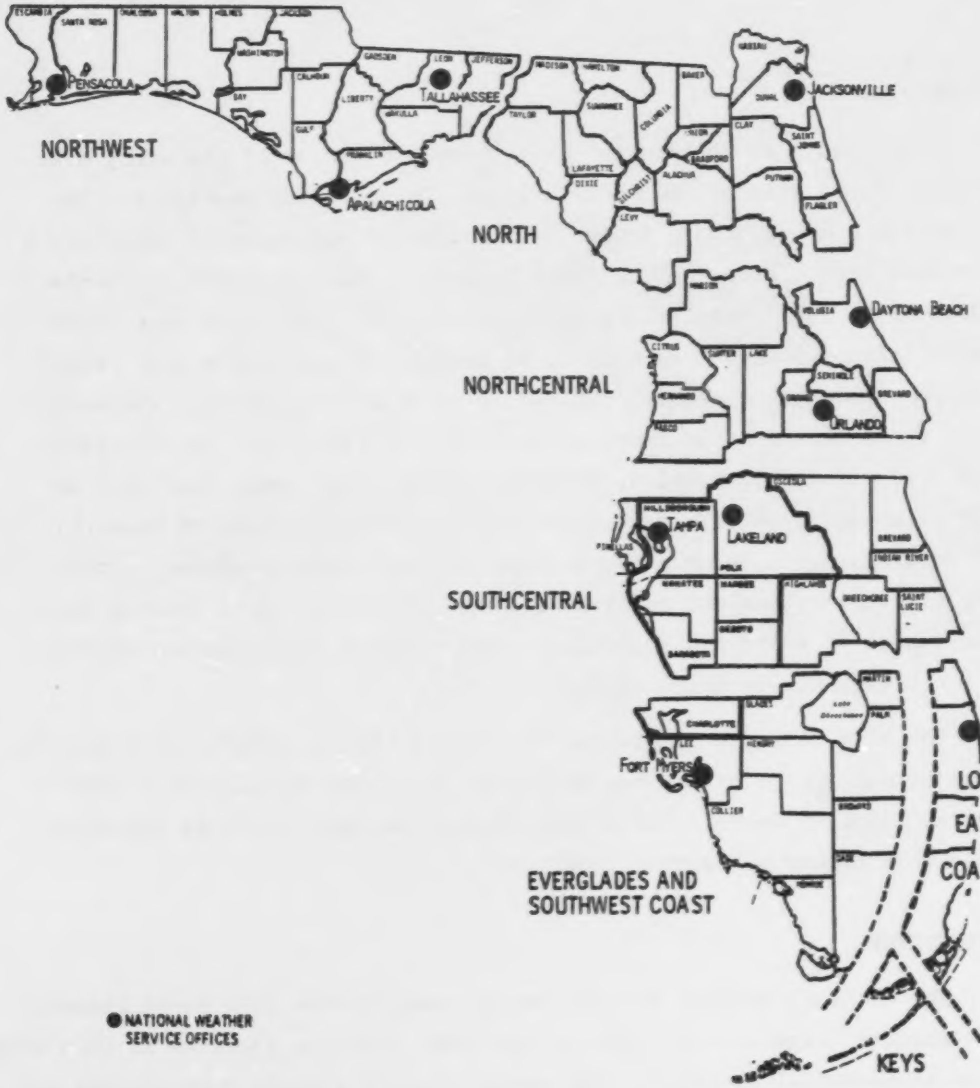
A. INTRODUCTION

The climate is subtropical in the seven counties of the study area - Hillsborough, Polk, Manatee, Hardee, Sarasota, De Soto, and Charlotte. The inland counties are subject to somewhat more diurnal and seasonal temperature variation than those bordering the coast because of the tempering influence of the Gulf of Mexico. Rainfall is abundant throughout the area on a year-round basis, although more than half of it usually occurs during the "rainy" months of June through September (Bradley 1974; USDA 1958, 1959). The area, because of its annual average temperature of 22.5°C (72-73°F), is especially sutied to agriculture and tourism; freezing seldom occurs more than once or twice per year, although 1976 marked one of the coldest periods in history: measured snowfalls were recorded where none had previously occurred. Occasionally, tropical storms and hurricanes pass through the area, causing wind and water damage to crops and buildings. Such tropical disturbances usually account for the record 24-hour rainfalls.

The mild climatic conditions in central Florida combine with shallow geological formations to permit the mining of phosphate deposits on a year-round basis. Similar deposits in a less tropical climate would be extracted at considerably higher operational costs.

B. TEMPERATURES

The National Weather Service has divided Florida into seven climatological districts (Figure 1.1). Six of the seven counties involved in this study are in the southcentral district. The normal monthly average temperatures for this district for two periods of record appear in Table 1.1. These "normal" temperatures, which are based on 30 years of records, indicate that there was little change in average temperatures between 1960 and 1970.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SOUTHCENTRAL
WEST PALM BEACH
FORT MYERS
LOWER EAST COAST
EVERGLADES AND SOUTHWEST COAST
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Figure 1.1. Climatological Districts of Florida

Table 1.1. Normal Temperature for Southcentral District

Month	1941-70*	1931-60**
	Temperature	
	°C (°F)	°C (°F)
Jan	16.4 (61.6)	16.9 (62.4)
Feb	17.2 (62.9)	17.7 (63.8)
Mar	19.4 (66.9)	19.4 (67.0)
Apr	22.3 (72.1)	22.1 (71.8)
May	24.8 (76.7)	24.9 (76.8)
Jun	26.8 (80.3)	26.9 (80.4)
Jul	27.6 (81.6)	27.6 (81.6)
Aug	27.7 (81.9)	27.8 (82.0)
Sep	26.9 (80.5)	27.0 (80.6)
Oct	23.9 (75.0)	23.9 (75.1)
Nov	19.8 (67.7)	19.9 (67.9)
Dec	17.1 (62.8)	17.4 (63.4)
Annually	22.5 (72.5)	22.6 (72.7)

*Thompson 1976
**Bradley 1974

Table 1.2. Freeze Data, 1921-50*

Location	No. of Occurrences <0°C (32°F)
North	
Tampa	16
Lakeland	17
South	
Punta Gorda	8
Arcadia	41

*Bradley 1974

Figures 1.2 and 1.3 are temperature records showing highs and lows as well as means for two reporting stations, Tampa and Lakeland. Tampa's maximum recorded temperatures were slightly lower than Lakeland's, indicating some influence of the nearby bays and the Gulf of Mexico.

The occurrences of frost conditions inland would be expected to be more numerous than those near the coast. Table 1.2 indicates the number of times the temperatures fell below 0°C (32°F) at four weather stations in the study area. The inland sites of Lakeland and Arcadia have recorded more frost "incidents" than have the coastal towns of Tampa and Punta Gorda. Although the incidence of freezing temperatures is very low in the study area, a single occurrence lasting more than a few hours can severely damage crops, especially citrus.

C. PRECIPITATION

Rainfall in the study area is plentiful. The normal annual rainfall in the southcentral district is 135-137 centimeters (53-54 inches). The normal monthly rainfall values for two periods of record

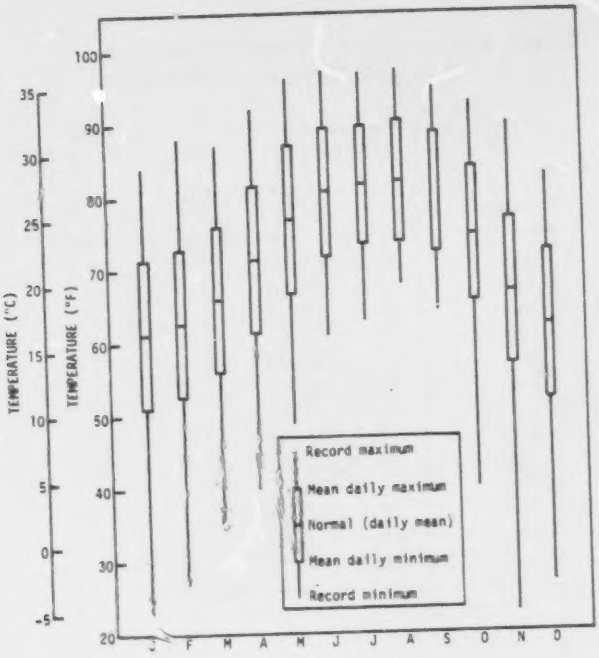

Figure 1.2. Tampa, Florida, Temperature Data (Bradley 1974)

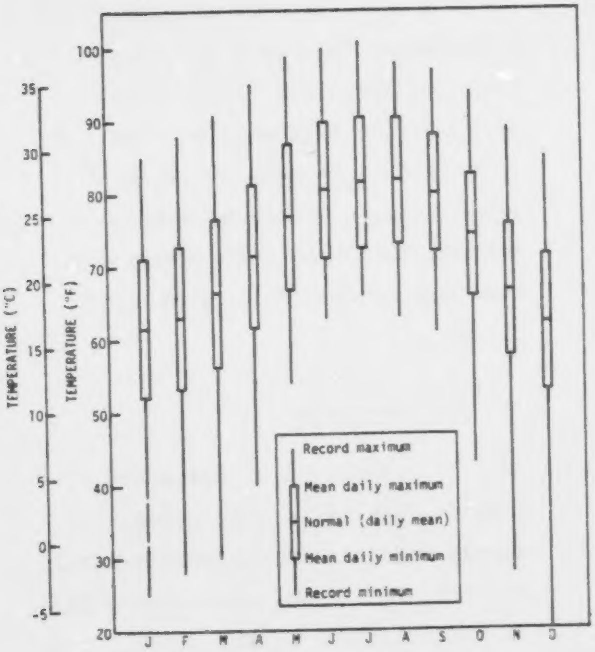

Figure 1.3. Lakeland, Florida, Temperature Data (Bradley 1974)

Table 1.3. Normal Rainfall for Southcentral District, 1941-70

Month	1941-70*		1931-60**	
	Rainfall			
	cm	(in.)	cm	(in.)
Jan	5.77	(2.27)	5.31	(2.09)
Feb	7.01	(2.76)	6.71	(2.64)
Mar	9.32	(3.67)	9.12	(3.59)
Apr	6.81	(2.68)	6.59	(3.38)
May	8.71	(3.43)	8.99	(3.54)
Jun	18.57	(7.31)	18.47	(7.27)
Jul	20.32	(8.00)	20.68	(8.14)
Aug	19.58	(7.71)	19.38	(7.63)
Sep	19.05	(7.50)	19.79	(7.79)
Oct	10.21	(4.02)	10.52	(4.14)
Nov	4.75	(1.87)	4.50	(1.77)
Dec	5.05	(1.99)	4.72	(1.86)
Annually	135.08	(53.18)	136.75	(53.84)

*Thompson 1976
**Bradley 1974

appear in Table 1.3. The normal annual total rainfall is slightly less if the period of record is shifted from 1931-60 to 1941-70. This drop is due to an extended period of lower-than-normal rainfall that has existed in central Florida since the early 1960s (Table 1.4). In Table 1.4, the incidence of monthly rainfall below the median, based on 1915-74 data, is illustrated for the period of record, 1960-75. Both Tampa and Lakeland have more occurrences below the median than would be expected.

On an annual basis for the entire southcentral climatic district, rainfall exceeded the "normal" values only twice between 1960 and 1976: those years of higher-than-normal rainfall were 1960 and 1969. The total deficit during the period amounted to approximately 1 year's rainfall (NOAA 1960-76).

Table 1.4. Below-Normal* Rainfall in Central Florida for 16-Year Period, 1960-75

Month	Expected No. of Occurrences	Occurrences in Tampa	Occurrences in Lakeland
Jan	8	10	9
Feb	8	5	7
Mar	8	9	10
Apr	8	13	13
May	8	11	8
Jun	8	10	10
Jul	8	7	11
Aug	8	8	7
Sep	8	10	10
Oct	8	9	9
Nov	8	8	9
Dec	8	7	7
Percent below median	50.0	55.7	57.3

*Months below median values based on 1915-74 (SWFMD 1977).

Rainfall data specific to Tampa and Lakeland are shown in Figures 1.4 and 1.5. The 4-month rainy season (June-September) is apparent on both illustrations. Both Tampa and Lakeland had a small maximum in March, followed by a dry period before the major rainy season began in June. Maximum monthly values tended to be higher at Tampa than at Lakeland because tropical storms dissipated near the coast and did not extend as far inland as Lakeland.

Table 1.5 presents the 24-hour record rainfalls by month for Tampa and Lakeland in the study area as well as for Ft. Myers to the south. These high rainfalls are usually in conjunction with the passage of a tropical storm. Central Florida's total rainfall is quite high, as is the number of days during which showers or thunderstorms occur. The incidence of measurable rainfall and thunderstorms is summarized in Table 1.6 for Tampa, Lakeland, and Ft. Myers. The predominance of rainfall incidents during June-September is again evident.

Table 1.5. 24-Hour Record High Rainfalls*

Month of Occurrence	Tampa cm (in.)	Lakeland cm (in.)	Ft. Myers cm (in.)
Jan	8.36 (3.29)	9.86 (3.88)	5.72 (2.25)
Feb	8.26 (3.25)	9.96 (3.92)	6.60 (2.60)
Mar	13.21 (5.20)	17.68 (6.96)	20.12 (7.92)
Apr	9.40 (3.70)	11.20 (4.41)	9.70 (3.82)
May	10.08 (3.97)	11.07 (4.36)	9.73 (3.83)
Jun	10.95 (4.31)	25.70 (10.12)	16.94 (6.67)
Jul	30.76 (12.11)	16.92 (6.66)	10.31 (4.06)
Aug	13.64 (5.37)	15.75 (6.20)	17.09 (6.73)
Sep	11.86 (4.67)	16.10 (6.34)	23.72 (9.34)
Oct	6.45 (2.54)	12.67 (4.99)	27.56 (10.85)
Nov	10.72 (4.22)	10.08 (3.97)	8.48 (3.34)
Dec	8.33 (3.28)	12.40 (4.88)	7.62 (3.00)

*Bradley 1974

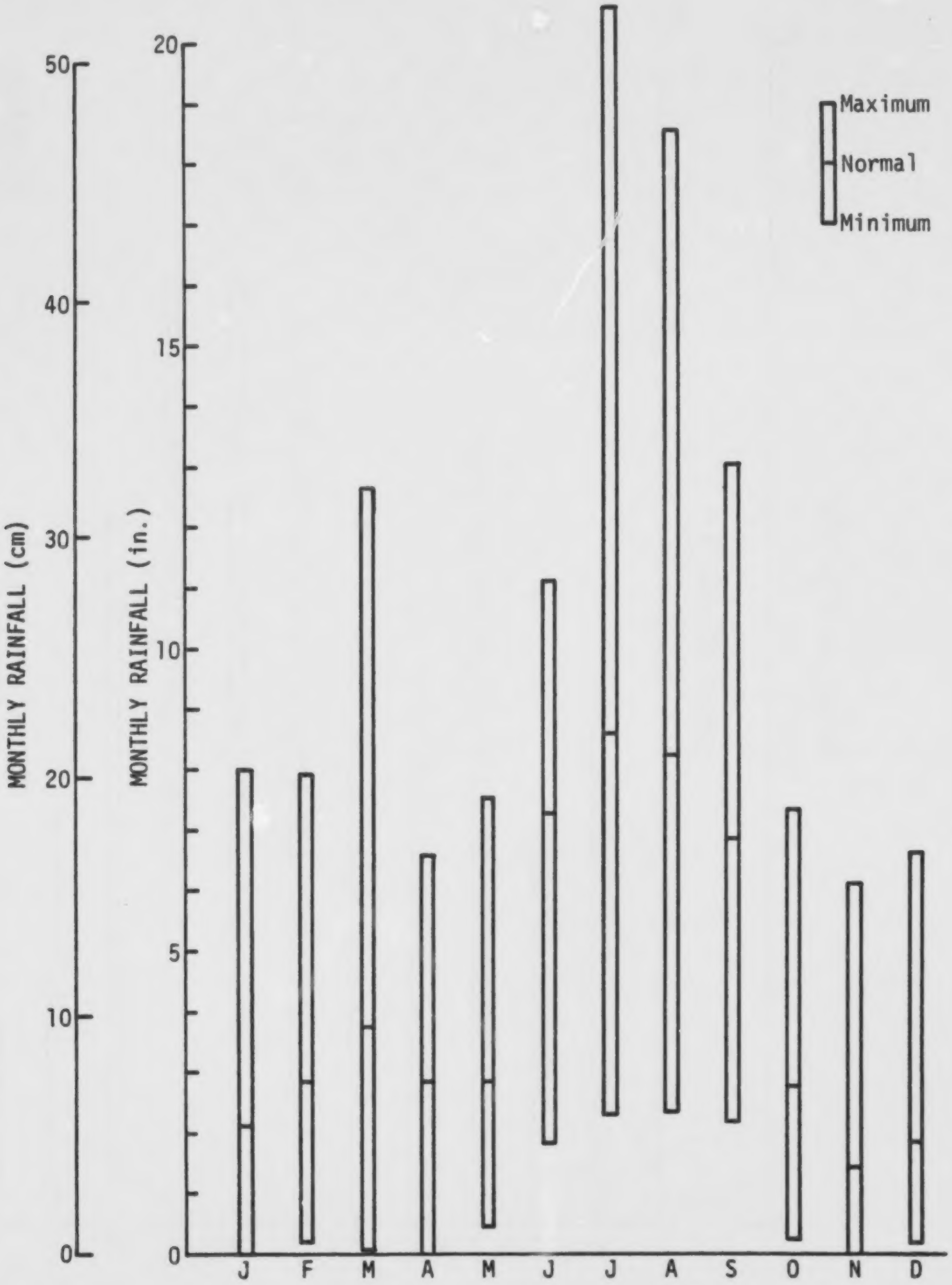

Figure 1.4. Tampa, Florida, Rainfall Data (Bradley 1974)

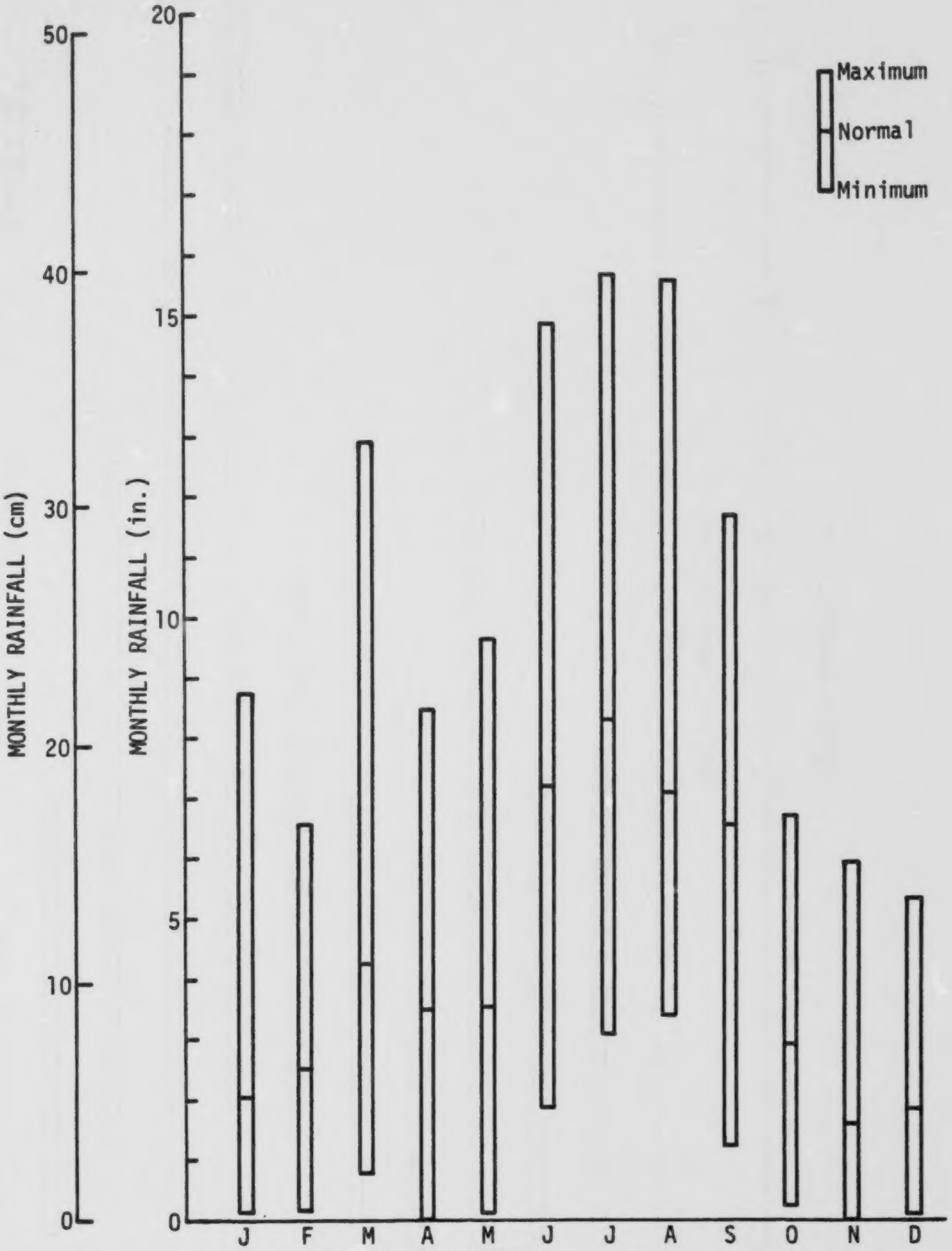

Figure 1.5. Lakeland, Florida, Rainfall Data (Bradley 1974)

Table 1.6. Mean Number of Days with Precipitation Exceeding 0.025 Centimeter (0.01 Inch) and with Thunderstorms*

Month	Tampa		Lakeland		Ft. Myers	
	>0.025 cm (0.01 in.)	T.S.	>0.025 cm (0.01 in.)	T.S.	>0.025 cm (0.01 in.)	T.S.
Jan	6	1	6	1	5	1
Feb	7	1	7	2	6	1
Mar	7	2	8	4	6	2
Apr	5	3	6	4	5	3
May	6	6	9	9	8	8
Jun	12	14	15	18	15	16
Jul	17	22	18	23	18	23
Aug	17	21	18	22	18	21
Sep	13	12	14	12	16	14
Oct	8	3	8	3	9	4
Nov	5	1	5	1	4	1
Dec	6	1	6	1	5	1
Total	108	87	121	100	115	96

*Bradley 1974

D. HUMIDITY AND FOG

As would be expected in an area of high rainfall and subtropical temperatures, central Florida's humidity also is moderate to high. Table 1.7 indicates the monthly highs and lows for Tampa and Ft. Myers. The highest humidity usually occurs around dawn, with the lows occurring in the early afternoon. Associated with the humidity is the occurrence of ground fog, which is observed most often during the winter (Bradley 1974). Most heavy fog dissipates rapidly after sunrise and is gone before noon. The average number of days with fog for Tampa, Lakeland, and Ft. Myers is also shown in Table 1.7.

Table 1.7. Recorded Humidity and Incidence of Heavy Fog*

Month	Tampa			Lakeland			Ft. Myers		
	Relative Humidity		Days of Fog	Relative Humidity[†]		Days of Fog	Relative Humidity		Days of Fog
	High	Low		High	Low		High	Low	
Jan	86	59	6	-	-	4	88	59	5
Feb	85	56	3	-	-	3	88	57	3
Mar	86	55	3	-	-	2	87	53	3
Apr	88	51	2	-	-	1	89	49	2
May	85	49	1	-	-	-	86	49	1
Jun	86	59	-	-	-	-	88	60	-
Jul	87	63	-	-	-	-	87	60	-
Aug	90	65	-	-	-	-	88	61	-
Sep	89	60	-	-	-	-	90	63	-
Oct	88	58	1	-	-	1	88	59	1
Nov	88	54	3	-	-	3	88	55	2
Dec	88	57	5	-	-	5	89	55	4

*Bradley 1974
[†] No data

E. WIND

Air movement over central Florida is generally constant, with winds prevailing from the northeast and averaging 6 miles per hour or more during most of the year (Bradley 1974). The average wind speeds and directions for Tampa, Lakeland, and Ft. Myers are presented in Table 1.8. Figure 1.6 shows directional wind roses for Tampa based on National Weather Service data from 1951 through 1960. The directions of the lines stemming from the center of the rose indicate the directions from which the wind blew; the lengths of the lines are proportional to the percent of time during which the wind blew from that direction. The top left of Figure 1.6 is the annual wind rose, indicating the predominating flow from north to west. The January wind rose (Figure 1.6) has a greater incidence of north or south winds, indicating movement of low-pressure systems through central Florida from the north. The remaining wind roses for April, July, and October (Figure 1.6) show a predominance of winds from the northeast quadrant.

Table 1.8. Prevailing Wind Speed and Direction*

	Tampa		Lakeland		Ft. Myers	
Month	Speed m/sec (mi/hr)	Dir	Speed m/sec (mi/hr)	Dir	Speed m/sec (mi/hr)	Dir
Jan	4.1 (9.1)	N	3.3 (7.3)	NE	3.8 (8.6)	E
Feb	4.3 (9.7)	E	3.5 (7.8)	NE	4.1 (9.2)	E
Mar	4.5 (10.0)	S	3.5 (7.8)	W	4.3 (9.6)	SW
Apr	4.3 (9.7)	ENE	3.4 (7.7)	E	4.0 (8.9)	E
May	4.1 (9.2)	E	3.1 (6.9)	E	3.7 (8.2)	E
Jun	3.8 (8.4)	E	2.8 (6.2)	E	3.3 (7.4)	E
Jul	3.4 (7.6)	E	2.5 (5.7)	S	3.1 (6.9)	ESE
Aug	3.3 (7.4)	ENE	2.5 (5.5)	NE	3.1 (6.9)	E
Sep	3.8 (8.6)	ENE	3.0 (6.6)	NE	3.5 (7.9)	E
Oct	4.1 (9.1)	NNE	3.2 (7.2)	NE	3.8 (8.5)	NE
Nov	4.0 (8.9)	NNE	3.1 (6.9)	NE	3.7 (8.3)	NE
Dec	4.0 (8.9)	N	3.1 (6.9)	NE	3.7 (8.3)	NE

*Bradley 1974

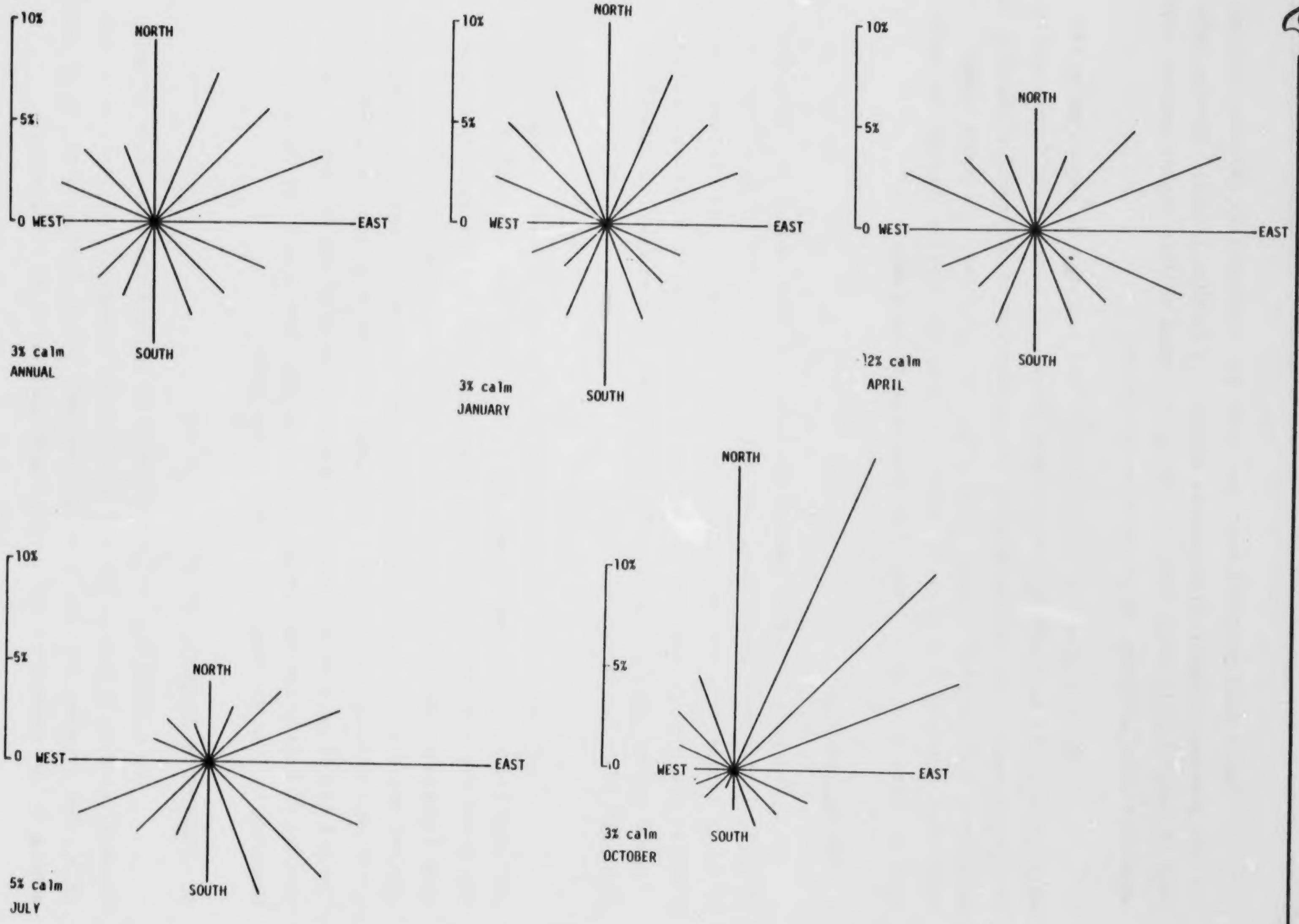

Figure 1.6. Wind Roses for Tampa, Based on 1951-60 Data (USGS 1970)

Daily wind patterns near the coast are dominated by land-sea breezes and are generally higher in magnitude than winds farther inland. This is evident in Table 1.8 in which both Ft. Myers and Tampa exhibit higher monthly averages than does Lakeland, which is situated inland.

Short-term winds of 20 to 30 miles per hour may be generated by the coastal land/sea interaction. Winds associated with winter cold fronts may be of similar magnitude, but the highest winds observed in central Florida will be associated with tropical storms, hurricanes, or tornadoes. In these cases, winds have exceeded 100 miles per hour. In general, airflow through the study area is quite good, with a very low incidence of calm days.

F. UNUSUAL WEATHER

Snowfall is highly unusual in central Florida and, until the winter of 1976, little more than traces had been observed. There is an average of 10 to 15 tornadoes a year throughout the state. Although they are most frequent in the spring, many are spawned later in the year in association with tropical storms and hurricanes. The ground path of tornadoes in Florida is generally short and damage minimum.

Tropical storms and hurricanes passing near or over Florida are a constant hazard during late summer and early fall. Over the past 87 years, the state has averaged 1.7 tropical storms per year and has never gone more than 2 years without such a storm. They tend to approach the state from the east or southeast in August or September, shifting to the south or southwest later in September and October. The study area would be most vulnerable during the latter part of the hurricane season (September and October). The chances of hurricane-force winds in a given year are 1 in 25 at Tampa, increasing to 1 in 11 toward the south at Ft. Myers.

G. DISPERSION CHARACTERISTICS

The climatology of Florida tends to enhance the dispersion of pollutants, leading to generally good air quality throughout the study area (ESE 1975). Sea breezes near the coast and moderate inland winds contribute to good mixing in the atmosphere and permit rapid dispersion of pollutants.

Approximately two-thirds of the available sunshine reaches the surface because of sparse cloud cover, enhancing vertical air movement and improving mixing. Figures 1.7 and 1.8 show the morning and afternoon mixing heights, which tend to represent an upper limit to the volume of the atmosphere available for dilution. The combination of moderate mixing depths and almost constant wind gives central Florida ventilation characteristics that are favorable to rapid dispersion of pollutants.

The lowest mixing depths occur in the early morning in association with radiation inversions caused by the cool ground tending to cool the lower levels of the atmosphere. These usually dissipate during the early morning hours after sunrise. The potential for extreme inversions, which could cause fumigation (intensive ground-level air pollution), is quite low in central to south Florida (Holzworth 1972).

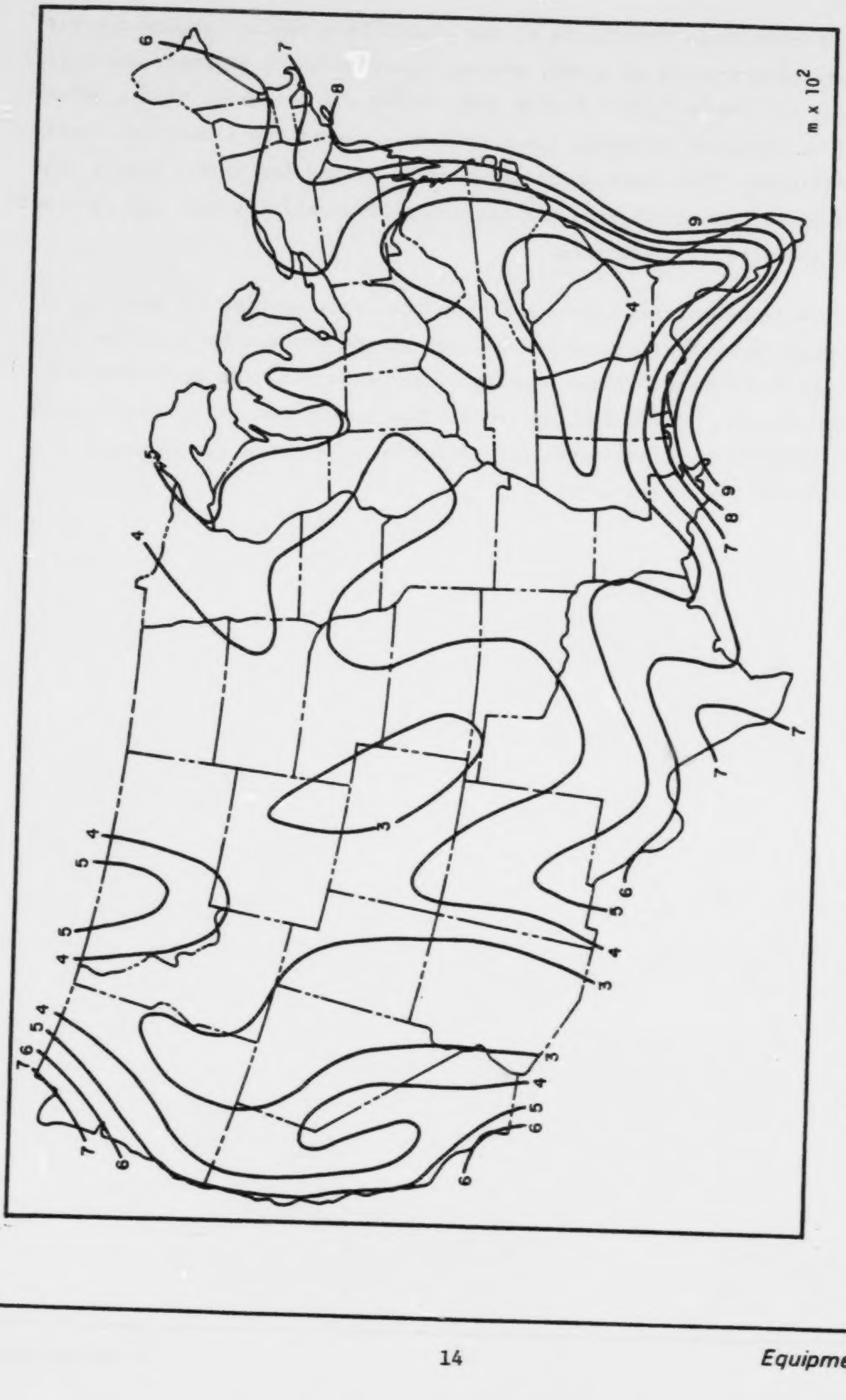
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Figure 1.7. Isopleths of Mean Annual Morning Mixing Heights (Holzworth 1972)

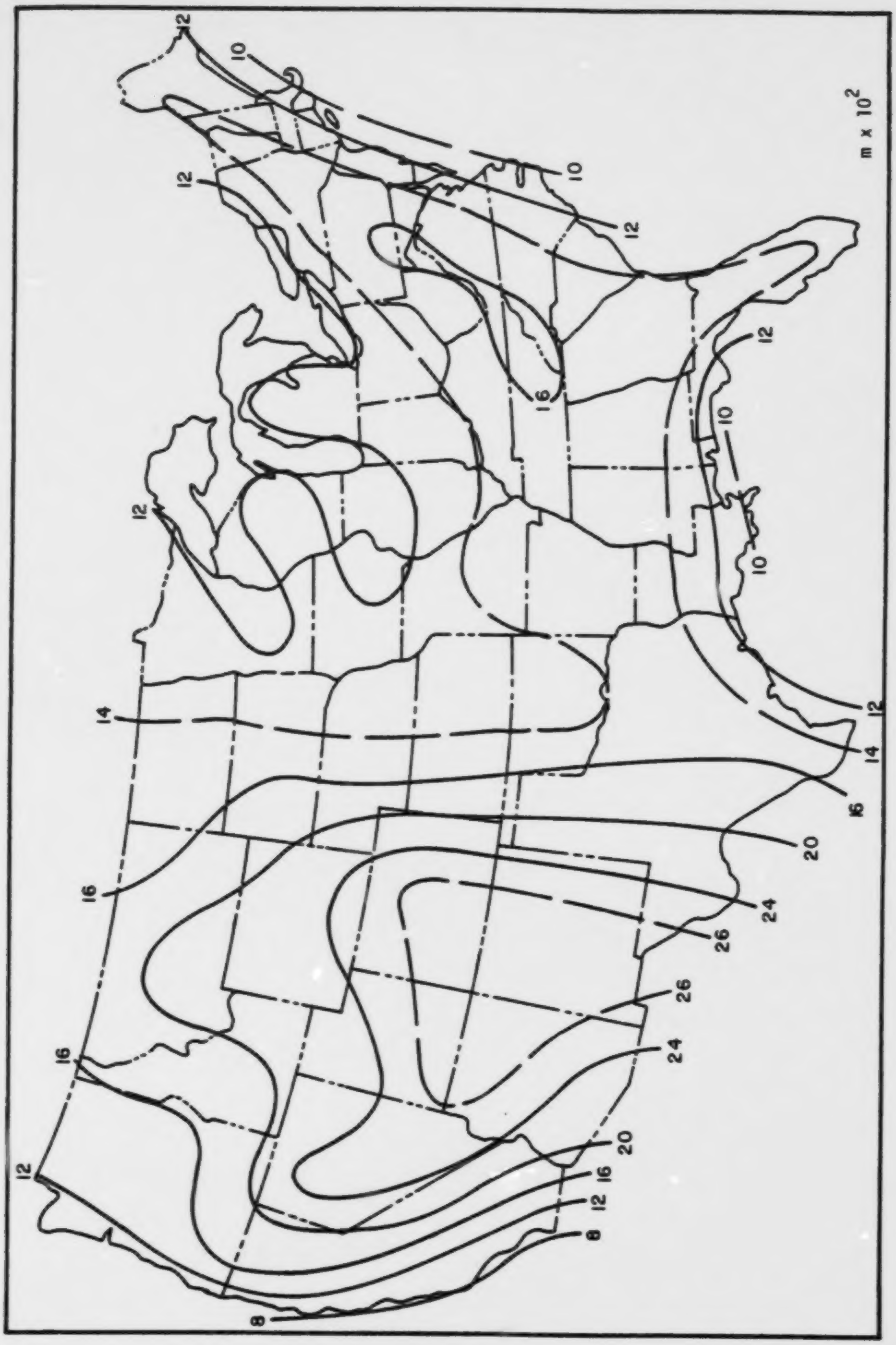
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Figure 1.8. Isopleths of Mean Annual Afternoon Mixing Heights (Holzworth 1972)

SECTION 2
AIR QUALITY

A. INTRODUCTION

1. Air Quality Overview

The objectives were to review existing data on air quality in westcentral Florida, as well as data collection methods, and prepare an emission inventory based on existing data which were to be supplied by the EPA, the Florida Department of Environmental Regulation (DER), local air pollution agencies, and other special projects or industrial sources if available. The most applicable special project, the Florida Sulfur Oxides Study (FSOS), was not to have delivered its final report until after the latest date for TI's data requirements.

The air quality data that were reviewed are summarized in this report, as are the collection methods. Vegetative fluorides have been evaluated based on data supplied by the Florida DER.

An emission inventory for 1974 and 1976 (detailed to plant but not stack level for point sources) is presented in this report. Data on radon levels in the study area were not adequate to evaluate air quality relative to radon as a pollutant. Air quality modeling in Polk and Hillsborough counties by Pedco for the EPA has been reviewed, but there has been no new modeling in conjunction with this report.

Only Polk and Hillsborough counties in the study area have consistently exhibited levels of air pollutants sufficiently high to indicate the likelihood that state and federal air quality standards have been exceeded (USEPA 1972; Pedco 1976a, 1977; Bowman 1977; Urone and Chadbourne 1977). While the remaining counties in the study area are subject to some local or transient air pollution problems, they generally exhibit low levels of air contamination because they are not extensively developed. Because of the airflow and mixing properties that exist in the central Florida atmosphere, the study area has a very low tendency for air pollution episodes which lead to ground level concentrations exceeding air quality standards (Holzworth 1972). Only where extensive industrial or municipal development exists — e.g., the Tampa area and the southwest part of Polk County — do air quality problems tend to arise; the primary source categories for pollutants in these two trouble areas are the phosphate industry and the steam electric generating facilities of the utilities.

2. Pollutants of Concern Because of Phosphate Industry Activities

The primary air pollutants associated with the phosphate industry are SO_2, dust, soluble and insoluble fluorides, and radon-222. For SO_2 and dust [as total suspended particulates (TSP)], air quality standards exist at the state and federal levels (U.S. 1971, DER 1975), but there are no ambient air quality standards at this time for fluorides or radon-222, nor do standard sampling methods exist at the ambient air quality level. Other air pollutants restricted by state or federal air quality standards may be associated in some manner to the activities of the phosphate industry, but the effect of the industry on ambient levels is masked by other, more prominent sources.

The air pollutants to be considered in this report arise from various phosphate industry activities:

- Sulfur dioxide originates primarily from the burning of sulfur containing fossil fuels and the manufacture of sulfuric acid from elemental sulfur (Pedco 1976a, EPA 1977).
- Dust is generated by fuel-burning, drying, grinding, and material transport, as well as by some stages of mining (Pedco 1975a, 1976a, 1976b).
- Fluorides arise from various chemical processes, drying and calcining, fluoride removal for feed preparation, and gypsum and cooling-water ponds (ESE 1977; Tessitore 1975, 1976).
- Radon-222 is the radioactive decay product of uranium-238, which is found in the phosphate deposits. The disturbance of the ground formations by mining activities leads to a redistribution of the uranium and its decay products (Guimond and Windham 1975).

3. Data Sources

The primary source of air quality and source emission data for this report was the Florida Department of Environmental Regulation (DER), but additional information was obtained from other public agencies and some private industry sources. The following list cites the primary data sources:

- Florida Department of Environmental Regulation
- Hillsborough County Environmental Protection Commission
- Manatee County Pollution Control Department
- Sarasota County Department of Environmental Control
- EPA Region IV (Air Programs Office and EIS Division)
- Florida Sulfur Oxides Study, Inc.
- CF Industries
- Florida Phosphate Council

In many cases, information was in the form of reports prepared by individual industries or contractors for the agency listed.

B. AIR QUALITY DATA

1. Air Quality Standards

Only two of the air pollutants considered in this report — SO_2 and particulates, the latter as total suspended particulates (TSP) — are regulated by state and federal air quality standards (Table 2.1). As the table indicates, except for the 3-hr SO_2 standard, the state regulations are more restrictive than the federal regulations.

Table 2.1. State and Federal Air Quality Standards for Sulfur Dioxide (SO_2) and Total Suspended Particulates (TSP)*

Pollutant	Florida ($\mu g/m^3$)			Federal ($\mu g/m^3$)		
	Annual	24-Hr†	3-Hr†	Annual	24-Hr†	3-Hr†
SO_2	60**	260	1300	80**	365	1300
Particulates (TSP)	60***	150	--	75***	260	--

*U.S. (1971), DER (1975).

**Annual arithmetic mean.

***Annual geometric mean.

†Not to be exceeded more than once per year.

2. Air Quality Data Collection Sites

The majority of the air quality data collected by public agencies in westcentral Florida is kept on file in Tallahassee by the DER. This DER data file has been the primary source of air quality data presented in this report. Contributing to the file are DER's Westcentral and South District offices, the Hillsborough County Environmental Protection Commission (HCEPC), the Manatee County Pollution Control Department (MCPCD), and the Sarasota County Department of Environmental Control (SCDEC or SCOPC) (Urone and Chadbourne 1977). CF Industries contributed additional air quality data from its Hardee County monitoring program, and a summary of 1976 data collected by IMC and Brewster in Hillsborough County was obtained from a summary of air quality monitoring sites in Hillsborough County prepared by Bowman (CF Industries 1976, Dames and Moore 1977, Bowman 1977, Urone and Chadbourne 1977).

The air quality sampling sites recorded in the DER files are listed by agency in Table 2.2; included are site names, SAROAD code numbers (area-site), and code numbers used to identify the sites shown in Figure 2.1.

Equal to the best data produced by industry to date, as well as being the most extensive, is that collected by CF Industries in Hardee County. Table 2.3 lists CF Industries sites (also shown in Figure 2.1) and indicates the type of samples collected at each.

More detailed information on the DER reporting sites appears in Appendix 1; the sites are listed by ascending SAROAD number, station locations are given in Universal Transverse Mercator (UTM) coordinates, and the type of air quality data collection at each site is given.

As can be seen in Figure 2.1, the collection of air quality data has been concentrated around Tampa and near the coast in Manatee County. Data reported from eastern Hillsborough County and southwestern Polk County are less dense than would be desired to completely characterize the effects of the phosphate industry in this area.

Table 2.2. Air Quality Data Sites Listed in DER Files of Department of Environmental Regulation*

Agency	Local Name	Codes		
		Area	Site	Fig. 2.1
DER-South	Arcadia City Hall	0080	001	1
	Arcadia Public Works	0080	002	2
	DER-South Lab/Office	3760	002	3
DER-West	Albert Miles Grove	1800	040	4
	Bartow DOT	0180	001	5
	Bartow New	0180	002	6
	Lakeland	2160	001	7
	Scott Lake	2160	002	8
	Mulberry City Hall	2860	001	9
	Union Hall	3680	001	10
	Willard Rowe	3680	002	11
	Winter Haven	4880	001	12
HCEPC	Bayside School	4360	003	13
	Brandon Water	0370	001	14
	County BARN	1800	021	15
	County BARN	4360	018	16
	Davis Island Coast Guard	4360	035	17
	41 S. at 60 E.	1800	064	18
	40 S., E. of Gardinier	1800	054	19
	Grady School	4360	030	20
	ICWU Building	1800	066	21
	906 Jackson	4360	021	22
	315 E. Kennedy	4360	001	23
	1105 E. Kennedy	4360	002	24
	Keystone Park	1800	017	25
	Lutz School	1800	018	26
	Progress Village	1800	022	27
	MacDill Air Force Base	4360	034	28
	Plant City	3660	001	29
	Ruskin Fire Station	1800	003	30
	301 E. 7th Ave.	4360	020	31
	Gibsonton	1800	065	32
	Special Study	1800	080	33
	Sun City	1800	019	34
	Tampa Airport	4360	006	35
	Temple Terrace	4440	001	36
	311 S. 22nd St.	4360	024	37
MCPCD	County Line N.	2540	005	38
	Holland House	2540	008	39
	Holmes Beach	1865	001	40
	Lake Manatee	2540	004	41
	MCPCD Lab/Office	0320	002	42
	Mills House Parrish	0320	006	43
	Parrish Rutland Rd.	0320	003	44
	Palmetto Police	0320	004	45
	Palmetto Shell	3440	001	46
	Port Manatee	2540	012	47
	Reeders Dairy	2540	013	48
	SIP Trailer	0320	005	49
	Socolof Fish Farm	2540	011	50
	Whitfield Fire Station	2540	003	51
SCDEC	Court House	4080	001	52
	Longino	4100	001	53
	Myakka State Park	4100	005	54
	Sarasota Airport	4100	006	55
	SCDEC Lab/Office	4100	002	56

*Urone and Chadbourne (1977).

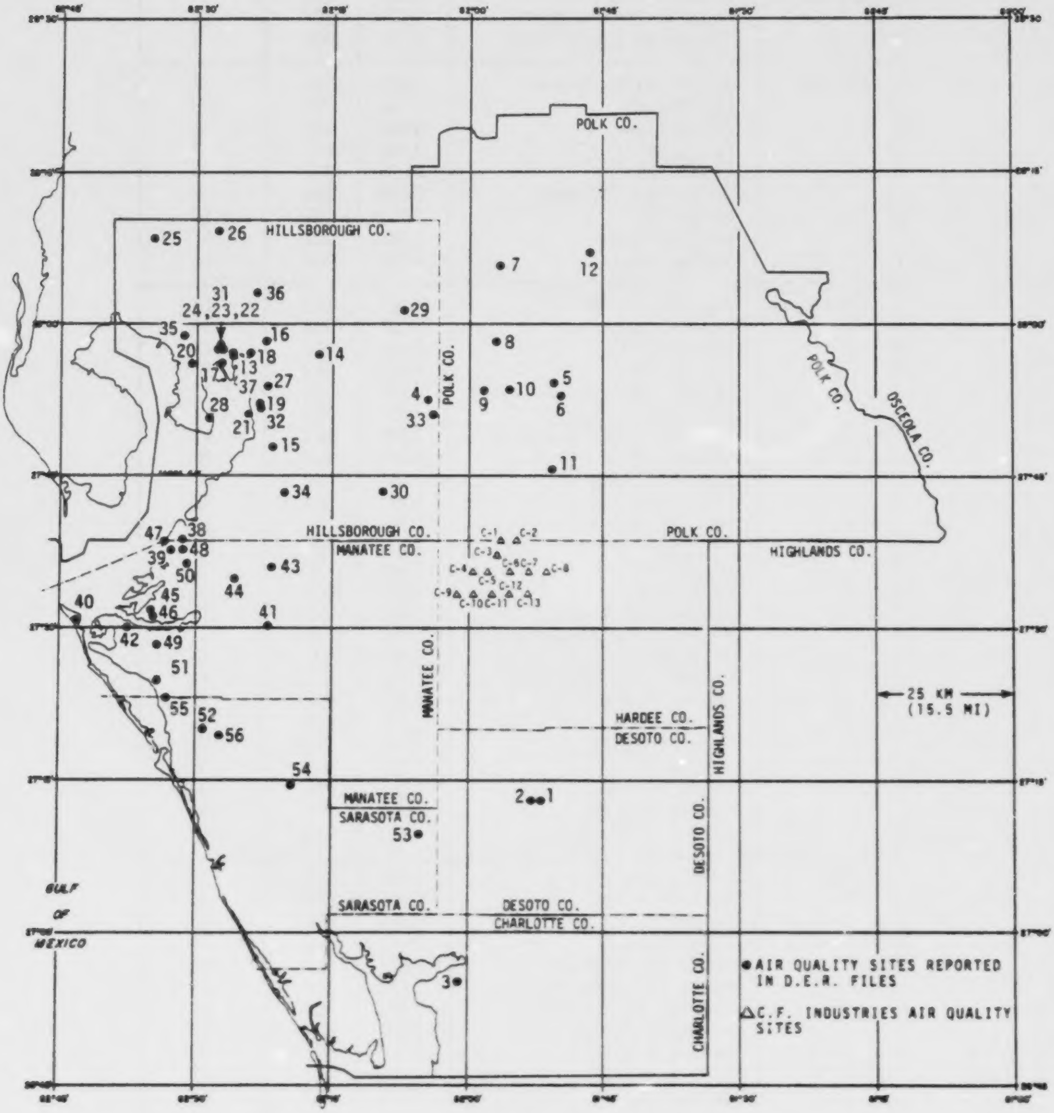

82°45'
82°30'
82°15'
82°00'
81°45'
81°30'
81°15'
81°00'
28°30'
POLK CO.
HILLSBOROUGH CO.
25
26
7
12
31
36
24,23,22
29
35
16
8
20
18
14
17
13
37
27
4
9
10
5
6
28
19
33
21
32
15
11
34
30
47
38
HILLSBOROUGH CO.
MANATEE CO.
C-1
C-2
C-3
C-4
C-5
C-6
C-7
C-8
C-9
C-10
C-11
C-12
C-13
POLK CO.
HIGHLANDS CO.
OSCEOLA CO.
POLK CO.
39
48
50
43
44
45
40
46
41
42
49
51
55
52
56
MANATEE CO.
HARDEE CO.
DESOTO CO.
HIGHLANDS CO.
25 KM
(15.5 MI)
54
MANATEE CO.
SARASOTA CO.
2
1
53
DESOTO CO.
GULF
OF
MEXICO
SARASOTA CO.
DESOTO CO.
CHARLOTTE CO.
CHARLOTTE CO.
3
● AIR QUALITY SITES REPORTED IN D.E.R. FILES
△ C.F. INDUSTRIES AIR QUALITY SITES

Figure 2.1. Locations of Air Quality Data Collection Sites in Westcentral Florida

Table 2.3. Air Quality Monitoring Program Summary for CF Industries Sites in Hardee County*

Sta. No.	SO_2 Continuous	SO_2 Weekly	Fluoride Weekly	Particulates Weekly
C-1	X	-	X	X
C-2	X	-	X	X
C-3	-	X	X	X
C-4	X	-	X	X
C-5	X	-	X	X
C-6	X	-	X	X
C-7	X	-	X	X
C-8	X	-	X	X
C-9 **	-	X	X	X
C-10**	-	X	X	X
C-11**	-	X	X	X
C-12**	-	X	X	X
C-13**	-	X	X	X

*CF Industries (1976).
**Stations serviced by mobile air quality trailer.

3. Air Quality Data Summary

The air quality data reported in the study area indicate that air quality standards are most likely to be exceeded in Polk and Hillsborough counties. Levels reported in the other counties are quite low (with some isolated exceptions), tending to be associated with localized transient sources such as construction or vehicular traffic.

The existing air quality data for phosphate industry-oriented pollutants are reviewed by pollutant type in the following sections. The air quality data are presented as they exist in the records. Any interpretations should take into account the effects of site location and sampling methods.

a. Sulfur Dioxide (SO_2)

Table 2.4 summarizes the number of times that state and federal 24-hour SO_2 levels were exceeded in the study area. The table is based on DER records of 24-hour bubbler data from 1972 to mid-1976 (Chadbourne 1977). The total number of incidents is infrequent and, because of sampling problems to be discussed in the next part of this report, is considered to be only a lower limit of the number that might actually have occurred during the period involved.

Table 2.4. Number of Times Air Quality Limit Exceeded for SO_2 at 24-Hour Sampling Stations, 1972 to Mid-1976*

County	Site Code	Year	State: Annual Arith Avg (60 $\mu g/m^3$)	State: 24-Hr Avg (260 $\mu g/m^3$)	Federal: Annual Arith Avg (80 $\mu g/m^3$)	Federal: 24-Hr Avg (365 $\mu g/m^3$)
Hillsborough	1800-054	1974	0	1	0	0
	1800-064	1974	0	1	0	1
	1800-065	1973	0	1	0	1
	1800-066	1973	0	1	0	1
	4360-021	1973	0	2	0	0
Polk	2860-001	1976	0	1	0	1
	3680-001	1974	1	1	0	0
		1975	0	1	0	0

*Chadbourne (1977).

Very little continuous SO_2 data were taken in the study area prior to 1976. Before that time, however, HCEPC operated at least two stations employing continuous SO_2 monitors (Bowman 1977, Pedco 1977). A summary of the 1972-75 data indicated that site 4360-021 (Tampa) exceeded the annual state standard once, the 24-hour state and federal standards seven and four times, respectively, and the 3-hour state/federal standard six times. These can be compared with the data from 24-hour samplers at the same site that indicated only two incidents exceeding the 24-hour state standard during the same time interval. This tends to reinforce the contention that existing 24-hour SC_2 data collected prior to mid-1976 underestimate actual levels of SO_2 existing during that period.

Countywide annual averages for the six counties reporting 24-hour SO_2 data to the DER file are summarized in Table 2.5. Hillsborough and Polk counties have the highest averages, but with apparent declines since 1974. DeSoto, Manatee, and Sarasota counties average less than 12 micrograms per cubic meter countywide. Considering that the 24-hour sampling method has a sensitivity limit of 25 micrograms per cubic meter without special calibration of the sampling apparatus, variations in these low levels are not significant (U.S. 1971).

All of the 24-hour SO_2 data recorded in the DER files from 1972 to mid-1976 are summarized in Appendix B by county and site for each year (Chadbourne

Table 2.5. Countywide Averages for Annual Arithmetic Average of 24-Hour SO_2 Data*

County	Micrograms per Cubic Meter				
	1972	1973	1974	1975	1976**
Charlotte	--	0	--	--	0
DeSoto	--	0	0	5	1
Hillsborough	17	29	24	15	12
Manatee	11	10	5	3	2
Polk	--	21	42	10	7
Sarasota	--	3	1	1	1

-- No data.
* Chadbourne (1977).
** Data reported to mid-1976.

1977, Pedco 1977). The number of observations and the highest two values recorded during each reported year were extracted directly from the DER data. Arithmetic means and standard deviations were calculated, as were geometric means and standard geometric deviations for each year. Assuming log-normally distributed data, the projected maximum 24-hour concentration (C_{MAX}) was calculated from the geometric mean (mg) and standard geometric deviation (Sg) from the equation (Larsen 1971, 1977; Urone and Chadbourne 1977):

$$C_{MAX} = mg \times Sg^{2.94}$$

Annual summaries of the available continuous SO_2 data from Hillsborough County (1972-75) are listed in Table 2.6. As shown in Table 2.7, it was possible to compare 24-hour and continuous SO_2 data from the two Hillsborough County sites for five individual years. The data indicated that the 24-hour samplers at those sites recorded levels that were only 42 percent of those recorded by continuous monitors located at the same sites. This is subject to error, depending on the quality of the data collected with the continuous monitors (Beckman coulometric sensors) (Bowman 1977) but does indicate the probable magnitude of the error involved in SO_2 data recorded by 24-hour monitors prior to mid-1976.

Table 2.6. Summary of Continuous SO_2 Data from Hillsborough County*

Site No.	Year	Arith Mean ($\mu g/m^3$)
4360-021	1972	104
	1973	78
	1974	56
	1975**	50
4360-035	1974	81
	1975**	56

*Pedco (1977).
**Some January 1976 data included.

Table 2.7. Comparison of Continuous and 24-Hour SO_2 Data in Hillsborough County*

Site No.	Year	Values 24-Hr Sampler/Continuous
4360-021	1973	0.44
	1974	0.39
	1975	0.42
4360-035	1974	0.38
	1975	0.45
Average		0.42

*Chadbourne (1977), Pedco (1977).

Bowman (1977) summarized the data collected by IMC and Brewster during 1976 at stations located on industry property in south and southeast Hillsborough County. Reported were annual arithmetic means for SO_2 data ranging from 2.6 to 12.0 micrograms per cubic meter, well below the limit of sensitivity for the sampling methods used. The data reported by CF Industries in Hardee County were collected by a more rigorous system of sampling and analysis that included some continuous SO_2 monitors as well as 24-hour samplers. The arithmetic average of the data collected by the continuous monitors from September 1975 to June 1976 was less than 13 micrograms per cubic meter; however, the maximum 24-hour average obtained by the continuous monitor was 87 micrograms per cubic meter. The maximum 24-hour data collected by a 24-hour sampler located approximately 3 miles south was 37 micrograms per cubic meter. These 24-hour levels were much higher than would have been expected from local sources in northern Hardee County; a detailed analysis of the highest levels recorded there, along with the wind direction prevailing at the time of the observation, shows that elevated levels can be observed at the CF Industries monitors when the wind blows from the direction of the phosphate plants north of the Hardee County monitoring sites. The highest levels were recorded at the two stations located closest to the Polk-Hardee county line.

None of the SO_2 data collected by the CF Industries network exceeded state or federal air quality standards. The periods of high readings from six continuous monitors of the firm are summarized in Table 2.8. The highest 1-hour and 3-hour averages associated with each incident, as well as the 24-hour average for the day of the incident, are shown; also, where data are available, the 6-hour average wind direction prior to the maximum reading is shown. The prevailing wind direction recorded during the episodes was NNE-NE, which aligns with phosphate industry sources in Polk County, the major SO_2 sources in the area.

b. TSP

The number of times that TSP is shown in the DER file from 1972 to mid-1976 as exceeding state and federal standards is summarized in Table 2.9. All of the observed incidents occurred in Hillsborough, Manatee, Polk, and Sarasota counties. The number of times the state annual and 24-hour standards were exceeded was considerably higher than observed for SO_2 data, partly because dust can be generated by a variety of sources and an individual sampling station can be dominated by a very local source such as a parking lot (unpaved), a street (paved or unpaved), or a construction site. In addition, the measurement of TSP in the study area has been the most accurate of the air quality parameters and hence tends to reflect the actual conditions at the sampling sites very accurately without sample decay or analysis problems such as those plaguing the SO_2, fluoride, or radon measurements.

Table 2.8. Continuous SO_2 Data Summary for CF Industries Showing Only Incidents of High Concentration*

Site	Date	Maximum ($\mu g/m^3$) Hr	3-Hr	24-Hr	Wind Dir., 6-Hr
C-1	11/18/75	130	89	27	NE
C-1	12/19/75	130	113	45	NNE
C-1	12/23/75	130	91	38	ENE
C-1	1/12/76	287	187	48	NE
C-1	1/16/76	104	85	42	NW
C-1	1/19/76	120	78	41	E
C-1	4/2/76	157	131	87	NNE
C-1	4/3/76	235	141	73	N
C-2	1/12/76	261	231	50	NNE
C-2	3/17/76	183	98	26	NE
C-4	10/29/75	261	136	32	NNE
C-4	12/23/75	144	104	42	ENE
C-4	1/16/76	151	133	43	NNW
C-4	1/19/76	99	81	44	NE
C-4	1/20/76	117	89	31	NE
C-4	1/23/76	104	78	-	N
C-4	1/29/76	102	82	35	-
C-4	2/22/76	188	145	30	NW
C-5	1/5/76	117	89	26	NE
C-5	1/12/76	157	132	32	NNE
C-5	1/16/76	117	100	35	NW
C-5	1/19/76	99	72	33	NNE
C-7	1/12/76	104	80	25	NNE
C-7	1/23/76	104	77	32	N
C-7	1/29/76	104	72	34	-
C-7	3/17/76	183	107	32	NE
C-8	1/18/76	104	85	41	N
C-8	1/29/76	110	82	30	-

*Dames and Moore (1977).

A detailed summary of all of the 24-hour TSP data recorded in the DER file from 1972 to mid-1976 is contained in Appendix C; the format is the same as that used in Appendix B for the SO_2 data. A countywide summary of the data in Appendix C is presented in Table 2.10. The TSP data shown indicate a background level of dust at 20-40 micrograms per cubic meter in the counties shown. CF Industries data in Hardee County also showed values of 23-45 micrograms per cubic meter in an undeveloped area subject only to agricultural traffic and some premining activity. On a countywide basis, DeSoto,

Table 2.9. Number of Times Air Quality Limits Exceeded for Total Suspended Particulates at 24-Hour Sampling Stations, 1972 to Mid-1976*

County	Site Code	Year	State		Federal	
			Annual Geom Mean (60 μg/m^3)	24-Hr Avg (150 μg/m^3)	Annual Geom Mean (75 μg/m^3)	24-Hr Avg (260 μg/m^3)
Hillsborough	0370-001	1973	0	1	0	0
	1800-064	1972	1	0	0	0
		1974	1	1	1	0
		1975	1	0	0	0
		1976	1	0	1	0
	1800-066	1972	0	1	0	0
		1974	0	1	0	0
	4360-001	1969	1	1	1	0
		1970	1	2	1	0
		1971	1	1	0	0
		1972	1	0	0	0
		1973	1	0	1	0
	4360-002	1972	1	0	0	0
		1975	1	0	0	0
		1976	1	0	0	0
	4360-003	1972	1	1	0	0
	4360-006	1972	0	1	0	0
		1973	0	1	0	0
	4360-018	1972	1	4	0	1
		1973	1	3	0	1
		1974	1	4	1	1
		1975	1	0	0	0
		1976	1	0	0	0
	4360-021	1973	1	8	1	0
		1974	1	2	1	0
		1975	1	0	0	0
		1976	1	1	0	0
	4360-024	1973	1	1	0	1
		1974	1	1	1	0
		1975	1	0	0	0
		1976	1	1	0	0
	4360-030	1973	1	2	0	1
		1974	1	0	0	0
	4360-034	1972	0	1	0	0
		1973	0	1	0	0
		1974	0	1	0	0
	4360-035	1973	1	6	1	0
		1974	1	7	1	0
		1975	1	0	0	0
		1976	1	0	0	0
	4440-001	1972	0	1	0	0
Manatee	0320-002	1971	1	3	0	1
		1972	1	0	0	0
	2540-003	1975	0	1	0	0
	2540-005	1974	0	1	0	0
	2540-008	1967	0	1	0	0
		1970	0	1	0	0
		1971	1	2	0	0
	2540-011	1974	0	3	0	3
	2540-012	1972	1	4	1	2
		1973	1	4	1	1
		1974	1	1	0	0
		1975	1	1	0	0
		1976	1	2	1	0
	2540-013	1967	1	1	0	1
	3440-001	1974	1	0	0	0
Polk	0180-001	1974	1	1	0	0
		1975	0	2	0	1
	2160-001	1974	1	0	0	0
		1975	0	1	0	0
	2160-002	1975	0	1	0	0
	2860-001	1973	1	0	0	0
		1974	1	7	1	0
		1975	1	6	1	0
		1976	1	6	1	0
	3680-001	1971	1	4	1	0
		1973	1	3	1	1
		1974	1	3	1	0
		1975	1	0	0	0
		1976	0	1	0	0
	3680-002	1973	1	1	0	0
		1974	0	2	0	0
		1975	0	1	0	0
		1976	0	2	0	0
	4080-001	1971	0	1	0	0
	4100-002	1975	0	3	0	1
	4100-006	1974	1	0	0	0
		1975	1	4	0	1

*Chadbourne (1977), Pedco (1977).

Table 2.10. Countywide Averages for Annual Geometric Mean of 24-Hour TSP Data*

County	Micrograms per Cubic Meter				
	1972	1973	1974	1975	1976†
Charlotte	--	21	30	27	26
DeSoto	--	43	44	52	53
Hillsborough	50	51	53	50	51
Manatee	51	46	45	40	36
Polk	40	64	71	64	49
Sarasota	--	37	45	44	42

*Chadbourne (1977).
†Up to mid-1976.

Hillsborough, and Polk counties remained very close to the state standard of 60 micrograms per cubic meter for the average annual geometric mean. The high readings in DeSoto County can be attributed partially to an unfortunate choice for the location of the single monitoring station; the apparent high levels were likely due to very local influences and did not reflect the levels existing throughout the county. In Hillsborough County, the most highly developed county in the study area, TSP levels have been high and fairly constant over the data reporting period shown in Table 2.10. Polk County, which exceeded state standards for the annual geometric mean on an average basis for three of the reported years, has shown a decline since 1974, which may be due in large part to the control devices that the phosphate industry has applied since 1974 to dusty operations.

The TSP data recorded by CF Industries appeared to be characteristic of relatively undeveloped areas. Only one data point recorded during September 1975-June 1976 exceeded the state 24-hour standard; this was reported to be due to the movement of heavy equipment in the area of the sampling station while the sample was being collected (Dames and Moore 1977, Urone and Chadbourne 1977). Table 2.11 summarizes all of the data showing TSP over 90 micrograms per cubic meter (24-hour). Only 16 data points fell into this category. Table 2.11 also shows the wind direction during the sampling periods that exceeded 90 micrograms per cubic meter. These data do not indicate that there was a strong dependence on north-to-south flow; this would tend to indicate that dust in the area was of more local origin than the SO_2 which caused high recorded values during the same time period. The dates of the high TSP recordings did not correspond well with those of the SO_2 maxima, also confirming the local nature of the dust sources.

Table 2.11. TSP Levels Exceeding 90 Micrograms per Cubic Meter at CF Industries Hardee County Site*

Site	Date	24-Hr ($\mu g/m^3$)	Wind Dir.
10	10/8/75	107	SSE
10	10/10/75	149	ENE
2	10/19/75	91	-
10	10/22/75	135	NE
2	10/25/75	156	-
9	10/27/75	146	ENE
10	~11/15/75	127	NNE
10	11/21/75	124	WNW
2	11/23/75	104	N
1	12/23/75	109	N
2	1/23/76	99	NE
8	2/11/76	90	NNW
8	2/17/76	97	S
8	3/22/76	97	NW
11	5/19/76	95	-
12	6/14/76	115	-

*Urone and Chadbourne (1977), Dames and Moore (1977).

c. Fluorides

All of the ambient fluoride data recorded in the DER data file from 1972 to mid-1976 are summarized in Table 2.12. There was only one annual average exceeding 5 micrograms per cubic meter — in 1972 in Manatee County where the most extensive data base on ambient fluoride levels exists. Sampling sites near phosphate industry sources showed the highest recorded values.

d. Radon

No air quality data pertaining to radon concentration exist in the DER air quality data base. Measurements of radon in the study area have been

Table 2.12. Air Quality Data Summary of 24-Hour Fluoride Data, 1972 to Mid-1976*

				Micrograms per Cubic Meter		
County	Site Code	Year	No. of Obs.	Arith Mean	Maximum 1st	2nd
Hillsborough	1800-040	1973	81	1	7	6
		1974	286	1	100	9
		1975	331	0	6	5
		1976	232	0	1	1
Manatee	0320-004	1974	29	1	3	2
		1975	49	0	1	1
		1976	35	0	0	0
	1865-001	1972	23	1	2	2
		1973	44	1	11	4
		1974	53	0	2	2
		1975	46	0	1	0
		1976	15	0	0	0
	2540-003	1972	24	0	2	1
		1973	45	1	9	5
		1974	51	0	1	1
		1975	46	0	1	1
		1976	17	0	0	0
	2540-004	1972	15	1	6	2
		1973	48	1	3	3
		1974	52	1	4	3
		1975	45	0	2	2
		1976	39	0	0	0
	2540-005	1972	48	1	7	7
		1973	32	1	2	2
		1974	41	0	1	1
		1975	48	0	0	0
		1976	40	0	3	0
	2540-008	1972	52	6	32	21
		1973	48	4	29	12
		1974	48	1	4	3
		1975	48	0	2	1
		1976	40	0	3	1
	2540-011	1972	24	1	4	2
		1973	50	1	3	3
		1974	42	0	1	1
		1975	39	0	2	2
		1976	33	0	8	3
	2540-012	1972	46	2	9	5
		1973	46	2	17	11
		1974	50	0	2	1
		1975	49	0	1	1
		1976	38	1	12	1
	2540-013	1972	50	1	6	4
		1973	42	1	5	4
		1974	51	0	4	1
		1975	50	0	3	0
		1976	31	0	0	0
	3440-001	1972	25	0	2	1
		1973	50	1	4	3
		1974	19	0	3	1
Polk	2160-002	1975	310	0	2	1
		1976	210	0	1	1
	3680-001	1973	82	1	4	4
		1974	278	1	7	4
		1975	241	0	2	1
		1976	215	0	2	2
	3680-002	1973	81	0	2	1
		1974	342	0	2	2
		1975	309	0	3	2
		1976	176	0	1	1
Sarasota	4100-001	1973	39	0	2	1
		1974	37	0	2	1
		1975	46	0	4	2
		1976	37	0	0	0
	4100-002	1974	10	0	1	0
		1975	34	0	2	1
		1976	36	0	1	0
	4100-005	1973	38	0	1	1
		1974	18	0	0	0
	4100-006	1973	41	0	3	2
		1974	55	0	4	1
		1975	49	0	2	1
		1976	36	0	1	0

*Chadbourne (1977), Pedco (1977).

made usually in connection with health hazards associated with radiation sources in general. A complete summary of the radiation problem in central Florida, including a summary of all of the reported work on radon, appears in Volume VI, Section 4, of this baseline report.

4. Review of Air Quality Sampling Methods

Although the air quality data existing for westcentral Florida prior to 1976 are fairly extensive, quantitative assessment is very difficult because of sampling problems and siting practice. This study considers it unfortunate that some of the least reliable data occurred in the area affected most heavily by the phosphate industry.

a. Problems Associated with Air Quality Sampling

The federal reference method (FRM), or some variation of it, was used to obtain most of the SO_2 data in the study area. Around 1975, it had become apparent that samples collected by this method had a thermal degradation problem arising from the temperature instability of the complex formed when SO_2 from the air was absorbed in the sampler. This was aggravated in central Florida because of the year-round high ambient temperatures (Pedco 1976a, Urone and Chadbourne 1977, Bowman 1977). Hillsborough County tests recorded sample losses ranging from 10 to 90 percent, depending on the details of the temperature history of each sample during collection and prior to subsequent analysis (Bowman 1977).

The lack of information on the thermal history of each sample precludes correcting the existing data quantitatively for thermal effects. In addition, sampler location and the collection methods have added to the uncertainty at many recording stations. Although steps were taken in 1976 to overcome the thermal degradation of SO_2 samples, all of the sites had not been modified as of June 1977.

Some minor problems concerning sample flow rates and moisture equilibrium of the collection filters also plague the collection of TSP samples. The major difficulty in TSP collection, however, lies in avoiding the location of samplers such that they respond only to very local influences. Although the data collected near an unpaved parking lot experiencing heavy traffic may truly indicate TSP levels in that area, they do not reflect accurately the air quality for a very large area around the sampling site; thus, an attempted evaluation of the dust loading in a city or county based wholly on sites subject to such local influences does not accurately establish the areawide levels that are of concern (Bowman 1977, Urone and Chadbourne 1977).

Sampling for ambient levels of soluble fluorides in central Florida has yielded data that contain generally quite low numbers. Since there are no standards for ambient fluorides, it is difficult to discern whether variations in these low numbers are significant. The sampling method itself, since it is not related to a federal or state air quality standard, is not fully characterized as to sensitivity limits or expected accuracy. Until a reference method (FRM) for ambient fluorides is established and standards are set for comparison, the evaluation of any fluoride sampling program will be difficult (Tessitore 1975, 1976).

As previously noted, air quality data (in the DER files) concerning radon concentrations in the ambient air in central Florida are nonexistent. Because evaluations of the concentration of this contaminant have been oriented toward radiological health studies, they are inadequate for a critical evaluation for the study area. (See Volume VI, Section 4, of this series of working papers.)

b. Details of Air Quality Sampling Sites

Most of the agencies and sampling sites just summarized have been subjected to a critical evaluation in conjunction with this air quality data analysis for the study area. The following sections discuss the problems and history of each site and the general methods of the respective agencies.

1) Sarasota County Department of Environmental Control (Urone and Chadbourne 1977)

SCDEC has collected air quality data at five locations, with the DER Air Quality Data Handling System (AQDHS) containing TSP and SO_2 data since 1973. Four of the stations are presently active; the fifth site, 4100-005 (Myakka), reported about 60 SO_2 and only four TSP values between February 1973 and June 1974. Site 4080-001 reports TSP data only. All of the SO_2 sites collect gaseous fluoride samples. Data from continuous ozone, nitrogen oxide, and hydrocarbon monitors since January 1976 have not been reported. Start-up problems and a lightning strike have limited the use of these data. There are plans for a new location (Verna Wells) to the northeast.

The samplers are serviced on Monday of each week, and sampling begins at midnight; samples are taken over 24 hours on Tuesday and refrigerated prior to analysis. Until November 1976, the state method employing Greenburg-Smith impingers and dry gas meters was used; fluoride samples are still collected by this method, but federal reference procedures (for SO_2 sampling) have been adopted. Since November 1976, temperatures for SO_2 have been controlled by leaving a frozen plastic container of water in each styrofoam sampling box. Suspended particulates are sampled with the federal reference standard hi-vol method.

Calibration and maintenance procedures for field equipment are being developed. Since November 1976, limiting orifices monitored with vacuum gages have been used to control flow in the SO_2 samplers. Calibration is done with a Tylan mass monitor. The purpose of this procedure is to minimize the uncertainty in previously collected data. Suspended particulate samples are taken 10 feet aboveground except at the court house (4080-001) and at the SCDEC office (4100-002). Brushes are replaced when they fail and a calibration then performed. The field technician has reported some problems with sticking visifloat meters. Prior to November 1976, equipment was serviced when it failed to operate, but dry gas meters were not calibrated; no correction for temperature or pressure was applied to the meter readings, and sample volumes were not carefully controlled. A galvanized pipe protruding 3 inches from the sampling box approximately 3 feet aboveground formerly served as a probe; the pipe was connected to the impinger with latex tubing. This configuration has been retained for fluoride sampling, but teflon probes approximately 3 feet aboveground have been installed with the federal reference upgrading.

Laboratory procedures are well documented in bound notebooks. Sulfur dioxide samples are analyzed each Wednesday (unless postponed until Thursday). A Coleman Junior Model 44 spectrophotometer is used for SO_2 analysis. The Coleman Model 55 with automatic sampling and flow-through cell has been used since October 1976. Some problems with variation in laboratory temperatures have been noted since constant temperature baths are not used. The lab director has been participating in the EPA interlaboratory SO_2 program since May 1975; at that time, all five interlaboratory analyses were very near the mean of the acceptable range, which was noteworthy since more than 50 percent of the participating laboratories failed the test. Subsequent participation was successful except when the sulfite samples were stored at room temperature prior to analysis; all of the samples were low after storage, indicating sulfite decay.

Fluoride samples are run each Friday using the Willard-Winter steam distillation with perchloric acid and silver perchlorate. The thorium nitrate titration is run after distilling 250 milliliters from a 150-milliliter sample and checking the pH. Although no temperature-humidity controlled weighing room is available, Gellman Type-A glass-fiber filters are stored for 24 hours in a desiccator over calcium chloride, preweighed, and stored in envelopes. After exposure, the folded filters are again desiccated for 24 hours and reweighed.

a) Court House (4080-001)

Data collection began about August 1973 at this site, which is located at roof level approximately 30 feet aboveground, an elevation not representative of sites sampling general city air quality. Only TSP is measured. Values have ranged from 20 to 114 micrograms per cubic meter. These are higher than nonurban backgrounds, as expected for a sampler operated in a city. If the site were at a 10-foot elevation available to existing fugitive sources, higher values would be expected.

b) Longino Ranch (4100-001)

Since early 1973, sulfur dioxide, fluoride, and TSP have been reported at this site, but no SO_2 sample has exceeded 25 micrograms per cubic meter. The highest reported value was 16 micrograms per cubic meter, which coincided with an elevated TSP reading of 80 micrograms per cubic meter. All other values have been less than 10 micrograms per cubic meter, and most have been near 0. Many TSP values have not exceeded 20 micrograms per cubic meter. The maximum reading was 110 micrograms per cubic meter. Most elevated values occur during the first half of each year when agricultural activity is highest.

The data suggest the influence of a dirt road approximately 10 feet to the west of the sampler: when this source is inactive, low background data are reported; during periods of activity resulting from winds or traffic, values may be elevated. Concurrently, elevated SO_2 readings may result from vehicle exhaust. No known point sources of SO_2 or particulate matter are expected to affect this receptor. A special 5-week study in July 1974 ran other samplers in the area simultaneously to compare sampling results. All monitors reported comparably low values.

c) SCDEC Lab/Office (4100-002)

Except for 5 weeks in April and May 1974, collection of data at this site (the samplers are on the roof of SCDEC's office approximately 200 feet aboveground) began in November 1974. The only SO_2 value exceeding 25 micrograms per cubic meter was 50 micrograms per cubic meter, which occurred during a period of very high TSP levels in December 1975 when the road adjacent to the office was being paved; all three December 1975 TSP readings (388, 243, and 159 micrograms per cubic meter) exceeded air quality standards. The reason for the number of elevated TSP values reported during the first half of 1976 is unknown. No apparent fugitive or point sources in the vicinity were expected to cause values exceeding 100 micrograms per cubic meter. Conceivably, particulate matter deposited on the roof may have been re-entrained on windy days, causing elevated concentrations.

d) Myakka Park (4100-005)

Twenty-four-hour sulfur dioxide data collection began in March 1973 and, before the site was discontinued in June 1974, four TSP samples had been collected — all below 30 micrograms per cubic meter. The site was adjacent to the state park truck farm where operation of internal combustion engines may have influenced SO_2 air quality. Although the maximum value reported was 19 micrograms per cubic meter, nearly 20 percent of the samples exceeded 10 micrograms per cubic meter.

e) Sarasota Airport (4100-006)

Sulfur dioxide measurements began in March 1973 and have yielded a maximum value of 40 micrograms per cubic meter, followed by 36 micrograms per cubic meter, with all others being less than 25 micrograms per cubic meter. Both maximum and average values have tended to decrease each year, although the significance of this decrease is not clear due to the relatively low concentrations encountered. Presumably, SO_2 levels at this site reflect changing fuel policies for aircraft or automobiles, both of which probably have an impact at this receptor.

A hi-vol sampler has been operated at this site since June 1974. Several samples exceeded 100 micrograms per cubic meter. This trend continued in 1975 when the maximum value was 297 micrograms per cubic meter and the annual geometric mean was 71 micrograms per cubic meter. Values exceeding 100 micrograms per cubic meter persisted in 1976. These data probably reflect local fugitive or mobile sources. Automobiles parking in the adjacent fields are expected to contribute significantly to the site's elevated values.

2) Florida DER South District Branch Office (DER-South)
(Urone and Chadbourne 1977)

The DER has operated at two locations in DeSoto County and at one site in Charlotte County since March 1973. Sampling has been intermittent for sulfur dioxide and on a 6-day schedule for TSP.

Prior to 1976, the old state method using Greenburg-Smith impingers and dry gas meters was employed. At Golf Course Blvd. (3760-002) in Charlotte County, 10 samples were collected from April through September 1973; sampling was not resumed at this site until August 1976, and all reported values were (0.0). Arcadia City Hall (0080-001) reported 42 values from April 1973 through

December 1975. The sampler was moved to the Public Works Department in January 1976 with SAROAD designation (0080-002), but this site was discontinued in 1976 when the westcentral region became responsible for DeSoto County.

On the 6-day schedule, samples are collected the day following exposure (unless on a weekend). An occasional sulfur dioxide sample has remained in the field for a few days. All of the data represent 24-hour integrated samples beginning at midnight. The samplers are not temperature-controlled, and there are no apparent plans to modify them. Samples are returned and stored in a refrigerator for analysis monthly. Hi-vol papers are weighed on a weekly basis.

Calibration and maintenance are performed twice annually. Limiting orifices and hi-vol brushes are changed at one station each week, on rotation, after approximately 6 months of sampling. The hi-vol and critical orifice needles are calibrated at that time. Due to infrequent SO_2 sampling, dry gas meters used prior to 1976 were calibrated before installation but not after. There has been no correction for temperature or pressure.

Laboratory procedures have been clearly defined with good record-keeping. A Coleman Model 124 double-beam spectrophotometer with flow-through cell is used for SO_2 analysis. Participation in the EPA interlaboratory SO_2 study demonstrated close agreement with standard analyses unless samples were stored prior to analysis. Some difficulty with pH sensitivity has affected the intercept of the SO_2 calibration curve, and there have been differences when samples have been reacted for 30 minutes rather than 60 minutes. As a result, an effective lower limit of sensitivity near 20 micrograms per cubic meter has been suggested.

Samples are run monthly so that approximately 30 samples can be analyzed each time. Hi-vol filters are preweighed after at least 24 hours in a desiccator over silica gel. After field exposure, they are stored in the desiccator in envelopes. Approximately 25 percent of the samples are reweighed to check results. Desiccant is used in the balance to minimize weight change during weighing. A controlled temperature-humidity weight room is not available.

a) Arcadia City Hall (0080-001)

All SO_2 samples at this site have been collected with the state method. Until 1975, all reported values were 0. Between March and December 1975, a maximum of 20 micrograms per cubic meter occurred in the samples collected, probably because of area sources such as space heating or vehicular emissions within the city. The low levels are consistent with expected SO_2 levels at this site. No significant point sources are expected to affect this receptor.

The 3-year sampling period yielded a maximum TSP value of 139 micrograms per cubic meter. Other readings exceeding 70 and 80 micrograms per cubic meter were probably caused by local fugitive sources. Although this site is probably representative of the immediate location, its high readings do not characterize DeSoto County.

b) Arcadia Public Works (0080-002)

At this site, 28 TSP samples were collected between January and June 1976. The maximum value was 148 micrograms per cubic meter. Local fugitive sources presumably caused these elevated values. Unpaved roads to the north and west contribute dust when they are activated by wind or traffic, and other fugitive sources include a railroad and barren surfaces 50 yards west.

The maximum reported SO_2 value was 14 micrograms per cubic meter, with internal combustion sources around the public works being the probable cause.

These data appear to be representative of air quality at the site but are not generally descriptive of the rural nature of DeSoto County.

c) DER-South Lab/Office (3760-002)

Only 17 SO_2 samples, all measuring 0.0. micrograms per cubic meter, are available from this site over a 3-year period. Since March 1973, a fairly regular 6-day schedule has been followed for TSP. The maximum value was 60 micrograms per cubic meter. The data are consistent with the location and are representative of rural Charlotte County, but they do not characterize urban areas within the county.

3) Manatee County Pollution Control Department
(Urone and Chadbourne 1977)

MCPCD data collection began in 1966 and, in 1972, seven new sites were introduced. The sampling program remained relatively static until July 1976. The Palmetto Shell (3440-001) site was discontinued in 1974, and the Whitfield fire station (2540-003) and Holmes Beach (1865-001) sites were discontinued in 1976. Two new SO_2 sites were added in 1976, but no data were available prior to September 1976. Reeders Dairy (2540-013) measures SO_2 and fluoride only. All of the other sites sample TSP, SO_2, and fluoride. Limited continuous-monitor SO_2 and ozone data collected with a Beckman 906A and Bendix total sulfur and ozone monitors have not been submitted to the DER files because of instrument operation and calibration problems.

Since no timers are used, the field technician stops the samplers approximately 24 hours after they are started. Sampling is conducted each week on different days. Weekends generally are not sampled. The samplers have no temperature control, but samples are analyzed either on the day collected or on the following day. The state method employing Greenburg-Smith impingers and dry gas meters has always been used for SO_2 sampling. Recently, teflon sample lines protruding 3 inches from the sampling box were installed; previously, latex tubing had been used. The fluoride samplers are identical except that the latex tubing has been retained. Standard hi-vol samplers are used for TSP data collection. All sampler inlets are approximately 4 feet aboveground.

Maintenance and calibration of dry gas meters and hi-vol meters are performed as needed. The corrosive nature of the SO_2 absorbing reagent leads to a 6-month life for meters. There are no facilities for calibrating the meters, but a local gas company has serviced and adjusted them. The meter volume has not been corrected for temperature or pressure.

Laboratory procedures are well documented and complete; results are recorded in bound notebooks. Participation in the EPA interlaboratory SO_2 program showed some very good results. Consistently low values occurred when the sulfite samples were stored prior to analysis. Fluoride was analyzed with the Willard-Winter steam distillation using perchloric acid and silver perchlorate. Quality assurance procedures for the fluoride analysis were extremely stringent, requiring that duplicate standards for three titrant ranges (low, medium, high) agree before analysis was begun. This was considered necessary since anticipated fluoride results were very low and the method entailed considerable uncertainty.

a) MCPCD Lab/Office (0320-002)

Sampling was begun at this site in July 1966 and is still active. Only suspended particulate samples are taken. The highest value ever recorded was 116 micrograms per cubic meter, but the geometric mean was 65 in 1972 and was often near 50. These data are representative of a light urban area that is not heavily influenced by fugitive sources.

b) Parrish Rutland Rd. (0320-003)

Sulfur dioxide and fluoride sampling began in October 1973, and a hi-vol was added at this site in February 1974. The highest sulfur dioxide value in 3 years of sampling at this site has been 51 micrograms per cubic meter; the second highest, 34 micrograms per cubic meter.

Particulate levels also have been very low, with a 3-year maximum of 97 micrograms per cubic meter. The geometric mean for TSP typically is 30 micrograms per cubic meter. These data are clearly representative of very good air quality at background locations in Manatee County.

c) Palmetto Police Station (0320-004)

Sampling at this site began in June 1974. SO_2, TSP, and fluoride samples have been fairly low, with 2 years of sampling yielding only one SO_2 value (49) over 25 micrograms per cubic meter and TSP maxima of 91 and 69 micrograms per cubic meter. No gaseous fluoride sample has exceeded 3 micrograms per cubic meter. The data are indicative of rural or small community background levels.

d) Holmes Beach (1865-001)

The maximum TSP value recorded in 4 years of sampling from July 1972 through July 1976 was 109 micrograms per cubic meter. These data are representative of the rural seacoast area where the sampler is located.

The maximum sulfur dioxide value was 62 micrograms per cubic meter. Highest values occurred in late 1972 and early 1973. Levels have decreased in recent years.

e) Whitfield Fire Station (2540-003)

During 4 years of sampling at this location, six sulfur dioxide values exceeded 25 micrograms per cubic meter. However, many values between 10 and 25 micrograms per cubic meter were recorded. The extreme southerly location removed from major point sources suggests the influence of internal combustion or open burning near this site.

The highest SO_2 reading at this site was 57 micrograms per cubic meter in 1973. The annual maximum TSP concentration ranged from 44 micrograms per cubic meter in 1976 to 174 micrograms per cubic meter in 1975; the second highest value in 1975 was only 86 micrograms per cubic meter. Most values at this site have been below 50 micrograms per cubic meter. Apparently, fugitive sources have occasional impact at this receptor.

f) Lake Manatee (2540-004)

Since July 1972, four SO_2 values exceeding 25 micrograms per cubic meter have been experienced at this site. Both the highest (88 micrograms per cubic meter) and second highest (63 micrograms per cubic meter) occurred in 1972; all other measurements during that year were very low. The cause of these elevated values is unknown. Until 1976, the annual maximum TSP value was less than 70 micrograms per cubic meter at this site.

This basically rural site has pasture on three sides and water treatment tanks to the east. The probable cause of elevated values is a road that curves around the base of the sampler approximately 15 feet below the embankment on which the sampler is located.

g) County Line North (2540-005)

This is one of four sites near Borden Chemical's Piney Point phosphate fertilizer complex. At this northernmost site, six SO_2 values have exceeded 25 micrograms per cubic meter; the maximum was 46 micrograms per cubic meter. These values are low probably because of the proximity of the sampler to a building on the east and a number of trees on the south. Air flowing from Borden Chemical sources does not have clear access to the sampler.

TSP levels at this site generally approximate 50 micrograms per cubic meter; on five occasions, however, values exceeded 100 micrograms per cubic meter, with the maximum being 220 micrograms per cubic meter. A dirt road servicing a house approximately 50 yards north of this site is probably responsible for values exceeding 100 micrograms per cubic meter, but the contribution from Borden particulate sources cannot be neglected.

h) Holland House (2540-008)

Since January 1972, 10 SO_2 values at this site have exceeded 25 micrograms per cubic meter. The highest and second highest were 200 and 114 micrograms per cubic meter, both of which occurred in 1973. Many of the samples at this site exceeded 10 micrograms per cubic meter, but values higher than 25 were infrequent. Values during late 1972 and early 1973 were much higher than at any other time. This site is due south of the Borden facility, with clear access to winds from the north. Suspended particulate levels are higher than rural background values, with the maximum reported as 124 micrograms per cubic meter.

i) Socolof Fish Farm (2540-011)

This site is located about 4 miles southeast of Borden in a basically rural environment. The maximum TSP value of 389 micrograms per cubic meter occurred in 1974. The highest SO_2 value of 99 micrograms per cubic meter occurred in 1972. In all, nine values exceeded 25 micrograms per cubic meter and all occurred prior to 1974. Although TSP levels are consistent with the rural environment, sulfur dioxide levels appear to reflect the influence of the fertilizer industry.

j) Port Manatee (2540-012)

The poorest air quality in Manatee County with respect to SO_2 and TSP characterize this location, which is west of Borden Chemical and east of both the port facilities and Belcher Oil Company. Loading and unloading of dusty materials at the port and numerous fugitive sources cause consistently high particulate levels. The maximum (659 micrograms per cubic meter) was recorded in 1972. The maximum in 1973 was 624 micrograms per cubic meter. Particulate air quality appears to have improved at this site in recent years but remains high.

The maximum sulfur dioxide level was 165 micrograms per cubic meter in 1972, when 30 percent of all values exceeded 25 micrograms per cubic meter. In 1973, 25 micrograms per cubic meter was exceeded by 40 percent of the values and in 1974 by 20 percent of the values. Values during 1975 and 1976 were much lower, with only one exceeding 25 micrograms per cubic meter. These data probably reflect emissions from both the Borden facility and Belcher Oil Company.

k) Reeders Dairy (2540-013)

Since January 1972, six SO_2 values exceeding 25 micrograms per cubic meter have been observed at this sampler to the east of Borden Chemical. The maximum, 73 micrograms per cubic meter, occurred in 1973. A number of physical structures at the dairy, as well as a row of trees, tends to obstruct airflow. No TSP data have been collected at this site.

l) Palmetto Shell (3440-001)

Particulate levels at this receptor have been consistently low and have never exceeded 100 micrograms per cubic meter. In all, 96 samples have been collected. Sulfur dioxide sampling began in July 1972 and was discontinued in April 1974. Ten values exceeded 25 micrograms per cubic meter; the maximum was 113. Local space heating is the apparent cause of elevated values.

4) Florida DER Westcentral Subdistrict (DER-West)
(Urone and Chadbourne 1977)

This agency has been operating nine sampling locations. The sampler in Hillsborough County (Albert Miles, 1800-040) measures SO_2 only. All of the other sites, which are in Polk County, sample both SO_2 and TSP.

Fluoride is measured at Willard Rowe (3680-002), Union Hall (3680-001), Brewster (3680-009), and Scott Lake (2160-002). Until mid-1976, SO_2 was measured daily at Willard Rowe, Union Hall, Albert Miles, and Scott Lake. A bank of Greenburg-Smith impingers sampled trailer air. Aluminum louvers and window screens covered the 2-foot by 2-foot openings on both sides of the trailer. Dry gas meters were used to record the volume sampled. The impingers were serviced weekly but were not rinsed after use; exposed reagent was poured out and the impingers recharged. Stopcock grease was not used, and probes were not considered necessary. Many of the rubber connectors were very old. It is important to note that samples, on the average, were left in the field for 3 days.

At Bartow (0180-001), Mulberry (2860-001), and Lakeland (2160-001), a 6-day schedule and midget bubblers are used. The samplers meet federal reference criteria with two exceptions: vacuum gages are not used to insure critical flow, and the limiting orifices are not checked before each sample. No probe was connected to outside air until 1976; the impingers were operated from the floor of the trailer, with the impinger 2 feet below one of the two 3-inch by 4-foot openings at the top.

Dry gas meters have been calibrated and hi-vol brushes changed at regular intervals, but there have been no corrections for temperature or pressure. This has been a time-consuming task, since more than 60 dry gas meters have been involved at the four daily sampling sites alone. Consequently, the interval between calibrations has been inordinately long. Maintenance of the gas flow systems has not been particularly good, as evidenced by aged rubber tubing and the amount of dust collected on the sampling trailer floors.

Laboratory methods are adequate, and recordkeeping is being improved at the suggestion of EPA personnel who visited the laboratory around October 1976. Hi-vol filters were desiccated before and after sampling, and no controlled humidity weight room was available. Participation in the EPA interlaboratory SO_2 studies has been problematical, presumably due to decay of the sulfite standards prior to analysis. Purified pararosanaline dye obtained from Eastman Kodak has been used since February 1975; before that time, the dye was purified and assayed in the Winter Haven laboratory. Fluoride is analyzed using steam distillation through perchloric acid.

a) Bartow DOT (0180-001)

After operation of this site was begun in November 1973, nine TSP and SO_2 samples included maximum values of 122 and 24 micrograms per cubic meter, respectively. In 1974, 35 percent (16) of all SO_2 values exceeded 25 micrograms per cubic meter. All values during the last 6 months of 1975 were 0 or 1, and the highest value thereafter until the site was discontinued in July 1976 was 33 micrograms per cubic meter. The reason for the sudden drop in recorded values is not known; however, the absence of a sampling probe and poor site location adversely affected consistency in the data. Sulfur dioxide data for this site cannot be clearly interpreted.

The TSP data also indicated sampling problems. The hi-vol located 10 feet aboveground was too close to several buildings, a trailer, and several trees, severely restricting airflow from all directions except the west. To the west, an active fugitive dust source provided the most significant impact on this site. A dirt road and an unpaved parking lot presumably caused numerous values to exceed 100 micrograms per cubic meter and a maximum of 464 micrograms per cubic meter in 1975.

This site was discontinued and another location established in June 1976 upon recommendation of the DER staff in Tallahassee.

b) Bartow New (0180-002)

This new site is only 3 kilometers from the old location, but the reported TSP and SO_2 values are very different. Through September 1976, 15 SO_2 values had been reported, and all except three were 0. The 15 TSP values ranged from 21 to 62 micrograms per cubic meter.

No fugitive sources influence the new Bartow site. Clear access from all directions over low hedges or grass provides excellent ventilation. A polypropylene probe extends to a height of 10 feet, and samples are promptly recovered on a regular schedule.

c) Albert Miles (1800-040)

Data collection at this site, which is in an orange grove with rows of 12-foot trees spaced 30 feet apart, began in September 1973. Only sulfur dioxide and fluoride are sampled. Since sampling began, six sulfur dioxide values have exceeded 100 micrograms per cubic meter, with the maximum of 154 micrograms per cubic meter being recorded in 1974. A significant decrease in values occurred in April 1975; after that, daily sampling continued but most reported values were near 0. No explanation for the sudden concentration drop is known, but the site is clearly affected by the phosphate industry.

d) Lakeland (2160-001)

At this site, sulfur dioxide values were moderately high until April 1975. More than half the values exceeded 25 micrograms per cubic meter. The maximum in 1976 was 32 micrograms per cubic meter. The cause of this dramatic decrease is unknown. Sources that influence this receptor include the two Lakeland utility power plants and possibly phosphate processors in Polk County.

Suspended particulate levels at this site are characteristic of a light urban area: the maximum in 1975 was 189 micrograms per cubic meter, and numerous values exceeded 60 micrograms per cubic meter.

e) Scott Lake (2160-002)

Data collection at this site began in 1975. Many of the SO_2 values have exceeded 25 micrograms per cubic meter, with a maximum of 203 micrograms per cubic meter being recorded. Dramatically, around April 1975, reported values became an order of magnitude smaller. The cause is unknown.

A maximum value of 155 micrograms per cubic meter for suspended particulate matter occurred in 1975, and many other values near 100 micrograms per cubic meter were recorded during the first half of that year. Concentrations during the second half of 1975 and during 1976 were considerably lower.

It is suspected that a highway 20 feet from this site has some influence, but a clear explanation of these data is unavailable at this time.

f) Mulberry (2860-001)

Sampling began at the Mulberry City Hall April 1973. The sulfur dioxide bubbler had no probe and was enclosed in a trailer. The highest SO_2 value (444 micrograms per cubic meter) occurred in March 1976, but the second highest recorded in 1976 was only 41 micrograms per cubic meter. On nearly all occasions during the 9-month period preceding the extremely high value, values were 0, a notable characteristic of the Polk County data. The highest 1975 value was 63 micrograms per cubic meter; only four samples that year exceeded 25 micrograms per cubic meter. A clear interpretation of these data is not possible because of the unusual changes in apparent air quality and sampling deficiencies.

A gravel parking lot 15 feet from the hi-vol sampler services the police station and local health agency as well as City Hall, and heavy traffic to the north and west on Highways 60 and 37 keep dust suspended. Consequently, the TSP geometric mean has always exceeded 60 micrograms per cubic meter and in 1974 was 97 micrograms per cubic meter. The highest value ever recorded at this site was 219 micrograms per cubic meter, but many values have exceeded 100 micrograms per cubic meter.

g) Union Hall (3680-001)

The Union Hall sampling site, which is about 0.34 mile south of Highway 60 midway between the towns of Bartow and Mulberry, is within the sphere of influence of a large number of phosphate fertilizer complexes and mining operations. The closest phosphate manufacturers — W.R. Grace, Royster, and CF Industries — are approximately 1.5 miles to the northeast, west, and south, respectively. The site was initially selected as an area of near maximum concentrations conveniently located with an available hard-surface road and a source of electricity. The area immediately north of Highway 60 extending at least 0.5 mile east and west lacks ground cover and experiences frequent earth-moving operations. Extensive truck and rail traffic 50 yards to the east and 250 yards to the north constitutes additional fugitive sources with expected significant impact.

The considerable SO_2 emissions throughout the area result primarily from the manufacture of sulfuric acid, which is used in the subsequent production of phosphate fertilizer. Because of heavy mining, truck traffic, and industrial activity throughout the area, TSP and SO_2 values at this site are the highest recorded in Polk County. Sulfur dioxide data in the DER file began in September 1973, with 80 percent of the values exceeding 25 micrograms per cubic meter and 213 micrograms per cubic meter being the maximum. In 1974, the maximum was 364 micrograms per cubic meter, 80 percent of the values exceeded 25 micrograms per cubic meter, and 20 percent exceeded 100 micrograms per cubic meter. Between January and March 1975, SO_2 values exceeding 200 micrograms per cubic meter occurred, but there was a dramatic decrease around March; no values exceeding 25 micrograms per cubic meter were reported after that time. There were a few high values in 1976, but they were generally much lower than in previous years. The cause is unknown.

Particulate levels are commonly over 100 micrograms per cubic meter. The maximum of 265 micrograms per cubic meter was recorded in 1973.

h) Willard Rowe (3680-002)

This site is in an orange grove approximately 150 feet from a dirt road between 15-foot trees. Elevated sulfur dioxide values were reported until early 1975. Particulate levels exceed 100 micrograms per cubic meter annually, with numerous high values presumably associated with fugitive emission sources.

i) Brewster (3680-004)

Sampling began in August 1976 at Brewster, which is located in an orange grove 100 feet from a paved highway. Because of the newness of this site, no data are available on the AQDHS tape. The gas sampling probe is approximately 8 feet and the hi-vol inlet approximately 10 feet aboveground. Data collected at this site should be representative of the general area, and there should be minimal fugitive source influence.

5) Hillsborough County Environmental Protection Commission (Bowman 1977)

Hillsborough County has been funded by EPA since 1968, and its monitoring activities have undergone annual evaluations to insure proper techniques and methods. HCEPC has not kept procedures and siting static during the period of this report. Siting changes have been made to minimize local bias. Standard operating procedures and quality control practices also have evolved steadily.

HCEPC uses the federal reference method, or "hi-vol" method, for monitoring levels of total suspended particulates. Samples are collected according to the national 6-day schedule, from midnight to midnight, and samplers are operated with 90-volt step-down transformers to keep the collection flowrate within FRM guidelines. Sample collection time is controlled at 24 hours ± 15 minutes using 7-day skip-timers. Plastic visi-float meters are used to determine sample flow before and after each collection cycle. The average flow is used in the calculation.

The hi-vol samplers are calibrated and maintained quarterly, with each quarterly data set bracketed with an initial and final calibration curve. Since January 1977, supervisory field audits have been performed monthly at each site, checking site conditions and sampler calibration.

Laboratory personnel inspect the collected samples as received and reject those showing excessive damage or leaks. Both clean and exposed filters are conditioned in a large desiccator over drierite or silica gel at 30 ± 5 percent relative humidity for a minimum of 24 hours prior to weighing. At least 7 percent of all weighings are repeated by the same analyst. Laboratory records are well kept in bound notebooks. Major sources of error are field-related (usually excessive calibration drift, leakage, or operator error during servicing).

The EPA federal reference method described in the April 30, 1971, edition of the Federal Register is used to measure 24-hour SO_2 levels. The sampling rate is controlled with hypodermic needles or glass orifices and is determined with soap-bubble buret measurements, corrected to 25°C, 760 millimeters for dry air, before and after each collection cycle. Samples showing flowrate changes greater than ± 10 percent are rejected. Supervisory flowrate audits at the mid-point of the sampling cycle have been in use since January 1977 to check operator performance. Field records are kept in bound notebooks. Only recently have temperatures during sample collection been controlled at 25°C or lower. Since September 1976, all samples have been transported under refrigeration from the field to the laboratory. In the laboratory, the collected samples are stored at 5°C until analysis. Laboratory calibration curves are generated monthly. Each analysis includes two standards; duplicates (7 percent) and spiked samples (7 percent). Color intensity of the prepared sample is measured on a Beckman 124 spectrophotometer with a flow-through cell. The laboratory routinely participates with excellent results in the interlaboratory SO_2 surveys conducted by EPA and FSOS.

HCEPC points out that all SO_2 measurements prior to the control of sampling and storage temperatures must be considered unreliable. The effect of thermal decay on SO_2 samples collected or stored at temperatures higher than 25°C has been well established by EPA and others. Also, an extensive study by the HCEPC within its network quantified the problem during 24-hour collection. It was determined that individual sample losses were between 30 and 90 percent, even with immediate storage after the 24-hour collection period, and that average losses were 40 to 50 percent, depending on the sample concentration; however, extended storage time in the field at temperatures above 25°C would increase these values. Because of the particular sampler design, there were no substantial differences between apparent summer and winter decay rates.

In the continuous monitoring of SO_2 levels since 1972, HCEPC has used four instrument types:

Instrument	Method	Equivalent Status
Beckman 906A	Coulometric titration	No
Meloy Total Sulfur	Flame photometric	No
Thermoelectron 43 (FSOS)	Pulsed UV fluorescence	Yes
Phillips 9755	Coulometric titration	Yes

The bulk of the historical continuous data has been collected with the Beckman instrument at two sites: Davis Island Coast Guard Station (4360-035) and 906 Jackson Street (4360-021). The Meloy total sulfur monitor was in use during a 2-year period between May 1972 and May 1974 at the Davis Island site; however, the data must be considered highly suspect since the instrument was not SO_2-specific and exhibited a lack of calibration stability (negative drift in almost all cases) which would have biased the data low. The Thermoelectron instruments provided by the FSOS have been in use since late 1976 at Simmons Park (1800-081), Davis Yacht Club (4360-040), MacDill Air Force Base (4360-041), and the USF Medical School (4360-039). The Phillips monitor was only in use for the last 2 months of 1976 at 906 Jackson Street.

Of the aforementioned instruments, the Phillips and the Thermoelectron are EPA-approved equivalent methods. In late 1976, the Thermoelectron monitor was discovered to react positively to aromatic hydrocarbons; an FSOS investigation into the problem indicated that the interference was severe, so its measurements prior to January 1977 are suspect. During January 1977, the factory modification to correct the problem was retrofitted to the instruments in Hillsborough County.

The Beckman 906A is known to respond to a variety of interferences including hydrogen sulfide, mercaptans, oxidants, and reductants. The instrument employs a selective scrubber, inert to SO_2, to remove the greater part of these interferences. Also, the concentrations of these pollutants are probably low enough to preclude a significant problem at the sites where the instrument has been used. A comparison between the Beckman and the temperature-controlled federal reference bubbler method shows very good correlation between the two for 24-hour determinations. Because of the thermal instability of the bubbler method, the Beckman 906A measurements were probably the most reliable data obtained prior to mid-1976. During 1972, the Beckman maintenance and calibration schedules were infrequent, usually in response to instrument malfunctions. From 1973 through 1975, instrument maintenance and calibrations were performed monthly. Beginning early in 1976, the full maintenance cycle was reduced to quarterly. Full multipoint calibrations were also performed quarterly or when a weekly 1-point calibration check showed drift greater than ± 15 percent; this calibration tolerance was decreased to 9 percent in 1977.

Maintenance cycles include flushing the sample cell and cleaning all inlet lines, rotometer, and regulator. Standard atmospheres of SO_2 in dry air are prepared using NBS permeation tubes housed in a Bendix air bath chamber-dilution system. Recently, Hillsborough County purchased two Hilton Industries calibration systems that use a water bath type of permeation chamber. Dilution airflows are measured with calibrated Hasting's mass flowmeters. Initial and final calibration curves bracket each data set.

The Thermoelectron and Phillips instruments are operated in a similar fashion, including quarterly calibration and maintenance cycles with weekly calibration checks.

a) HCEPC No. 1 - Health Department, Saroad 10-4360-002 (NASN Site)

At HCEPC site 1, the EPA National Air Surveillance Network (NASN) station in downtown Tampa north of the Hooker's Point-East Tampa industrial area, SO_2 and TSP have been measured since 1967. The port of Tampa, with its loading facilities and related transportation and commercial activities, is within 0.5 mile of the site on the south and east sides. TECO power generating stations Hooker's Point and Gannon, which line up 1 and 3 miles southeast, as well as the Florida Portland Cement plant, can be expected to have a significant impact on air quality at this site. In addition, commercial activity within the city itself constitutes an important source of contaminants.

HCEPC personnel collect samples on a 12-day schedule for EPA and ship them through the mail to the EPA laboratory in Athens, Georgia, for analysis. The SO_2 samples are not refrigerated during shipment but have been collected under refrigeration since November 2, 1976. Hillsborough County also obtains measurements at this site on a 12-day schedule by alternating with the EPA sample collection schedule. The Hillsborough SO_2 samples are refrigerated during transport. Non-temperature-controlled SO_2 measurements at this station may be much more reliable than those at other sites in the county network, however, since the sampling train is housed in a large, well ventilated white aluminum shed in which temperatures do not greatly exceed ambient. The samplers are located on the roof of the building approximately 50 feet above the street. Exposure is excellent in all directions except southwest where an elevator shaft/air conditioning shelter partially obstructs airflow. Because of the sampler intake height, the effect of localized ground-level fugitive emissions is minimal.

HCEPC considers the quality of its SO_2 measurements at this site superior to those available from EPA because of refrigeration of samples during both collection and transport and because samples can be processed immediately being shipped.

b) HCEPC No. 5 - Temple Terrace Water Plant, Saroad 10-4440-001 (Population-Oriented)

At HCEPC site 5, which is located in the north end of Temple Terrace, a small suburban community 8.5 miles northeast of Tampa's city center, TSP measurements have been gathered on a 6-day schedule since 1972 while 12-day data extend back to 1967. The major influences on TSP air quality are associated with commercial and residential activities in the vicinity of the sampling site. Thatcher Glass Manufacturing Company, the only major source in the area, is 2 miles west of the sampler.

On March 1, 1973, the sampler inlet was elevated to 15 feet on the roof of the water pumping building to minimize fugitive interference resulting from traffic within the plant compound; prior to this time, the sampler had been at ground level (inlet, 4 feet) adjacent to the south side of the pump building, where airflow was seriously obstructed on all sides. The present configuration offers excellent exposure for the sampler. The surrounding areas are either grass or paved. The employees' parking and the utility parking areas are about 100 yards north of the sampler and could cause a low level of fugitive interference. Since elevation of the inlet, both the annual geometric mean and 24-hour maximum TSP levels have dropped considerably, indicating that there was serious localized fugitive interference to the measurements prior to March 1973.

c) HCEPC No. 7 - Brandon Water Company, Saroad
10-0370-001 (Population-Oriented)

HCEPC local site 7 is located in Brandon, a suburb of Tampa that is about 11 miles east of the city center; 18 and 25 miles further east are the towns of Mulberry and Bartow, the center of Florida's phosphate fertilizer complex. Since 1967, this station has monitored 24-hour total suspended particulate levels, while 24-hr sulfur dioxide sampling has been performed since 1972.

Initially, the samplers were located at ground level, with the hi-vol sampler inlet at 5 feet and the SO_2 probe inlet at 8 feet. Obstructions by the maintenance shop and water tank limited sampler exposure on the south and west sides. On January 17, 1974, the samplers were moved to the roof of the maintenance shop to eliminate these obstructions and minimize the influence of fugitive dust interferences from the water plant activities. On September 9, 1976, the SO_2 bubbler was temperature-controlled by housing the train in a small refrigerator.

During 1972-76, the annual geometric mean values for TSP showed a gradual decline from 50 to 40 micrograms per cubic meter. The maximum observed 24-hour TSP concentrations also have decreased since elevation of the hi-vol samplers, indicating probable local fugitive influence in the measurements made prior to 1974. Sulfur dioxide measurements have been well below the ambient standards.

Sulfur dioxide emissions from Tampa and from the Polk County phosphate processors may contribute to the SO_2 air quality in Brandon. However, the distance from sources in Tampa and Polk County provide extensive opportunity for dilution under ordinary atmospheric conditions. Particulate sources in or near Brandon are expected to contribute the major fraction of suspended particulate matter.

The SAROAD station number was changed from 1800-002 in March 1973.

d) HCEPC No. 8 - Plant City Water Company, SAROAD 10-3660-001 (Population-Oriented)

HCEPC local site 8 is located in Plant City 25 miles east-northeast of Tampa and approximately 10 miles from Lakeland. Bartow and Mulberry are approximately 20 miles to the southeast. The 24-hour TSP samples have been collected since 1968 and the hi-vol federal reference method has been employed on a 6-day schedule since 1972. On April 3, 1973, the sampler was moved north approximately 100 yards and elevated from 4 feet to 20 feet aboveground. The change in location bias was apparently not reflected in the data, however. Geometric mean and maximum values from 1972 to 1976 remained approximately the same (47-55 micrograms per cubic meter) and indicated no violations of ambient standards.

The major influences on air quality at this site are local and associated with business and social activity within Plant City. Potential fugitive source influence from adjacent railway traffic and unpaved roads may contribute to observed values, although traffic in the vicinity of the water plant does not appear to be heavy.

e) HCEPC No. 9 - Ruskin Fire Station, SAROAD 10-1800-003 (Population-Oriented)

HCEPC site 9 in Ruskin is approximately 18 miles almost due south of the Tampa city center. The major point sources are two major power generating stations — TECO's Big Bend, which is 5.5 miles north of the site, and the FP&L Manatee River Station, which is 10 miles southeast of the site — and the Gardinier phosphate complex, which is 10 miles north. The Borden Chemical plant is 6-8 miles southwest of the station. These sources determine the SO_2 air quality at the site, while localized emissions probably provide the major influence on TSP levels.

Total suspended particulate data have been collected since 1968. Samples have been collected on a 6-day schedule since 1972. Since 1972, TSP concentrations have remained fairly constant, with geometric means of 34-40 micrograms per cubic meter. Elevation of the station above obstructions would increase the sampler response to any point source contributions to the TSP air quality over Ruskin. The samplers are located at ground level behind the fire station 10 feet from a dirt drive. Sampling intakes are 4 and 8 feet for TSP and SO_2 respectively. TSP sampler exposure is very poor, with obstructions caused by the firehouse (west), a storage shed (north), and a break of trees approximately 15 feet high (east). The area surrounding the site is unpaved. To minimize the effect of these very close obstructions and localized fugitive interference, the hi-vol sampler should be elevated by either moving it to the storage shed roof or by installing a platform in the far southeast corner of the property.

SO_2 exposure is adequate. The 24-hour SO_2 measurements began in 1973. SO_2 samples have been collected under refrigeration since September 9, 1976. Review of the measurements made since this date show an increase in measured SO_2 levels (maximum of 149 micrograms per cubic meter, 24 hours).

f) HCEPC No. 15 - Grady Elementary School, SAROAD 10-4360-030 (Population-Oriented)

HCEPC local site 15 is at the northern end of the Interbay peninsula 4.5 miles due west of Tampa's active city center and well within the hemisphere of influence of the city of Tampa. Dale Mabry Highway and Henderson Boulevard, both major Tampa arteries, meet approximately 0.25 mile east of the site. MacDill AFB and St. Petersburg, which are 7 miles south and 10 miles southwest, respectively, constitute major source influences with respect to sulfur dioxide and hydrocarbon emissions. The city of Tampa — with its power plants, extensive industry, and local commercial activity — constitutes significant particulate, sulfur dioxide, and other contaminant sources.

This has been the site of 24-hour TSP and sulfur dioxide sampling on a 6-day schedule since 1972 and TSP measurements since 1968. During this time, the samplers have been moved in an attempt to minimize local influence at the receptor. Prior to May 1974, the samplers were located in the vicinity of significant fugitive sources in the form of an unpaved parking lot; approximately 5 or 6 cars were generally parked in the unpaved lot east-northeast of the sampler on a daily basis. The apparent impact of fugitive sources on the site was considerable. Geometric mean and maximum concentrations of TSP reported in 1972, 1973, and 1974 indicated violations of the secondary mean standard and 24-hour primary standards. On April 30, 1974, the sampler was moved 300 yards north from the library at an elevation of 8 feet to Grady Elementary School at an elevation of 15 feet. Data collected since 1973 have shown a gradual decline to below the ambient standards (the 1976 geometric mean was 52 micrograms per cubic meter) and no 24-hour secondary standard exceedences.

The present location is excellent with respect to both source and population-oriented surveillance. No significant local fugitive sources are expected to have an impact at this receptor. Paved surfaces or grassy lawns extend in every direction from the sampler, which is located on the roof of the school building. Most of the other physical structures in the area are not tall enough, or are far enough away, to minimize topographical influences. The area is densely populated and representative of the air quality to which a great number of people in Tampa are exposed.

Sulfur dioxide data, subject to the limitations of the federal reference method, should be representative of the area since no significant fugitive sources are known. Considering the negative method bias and low sampling frequency, SO_2 concentrations exceeding the standard probably occur at this site, although temperature-controlled measurements from 1976 do not reflect this. Additional SO_2 and TSP samplers, possibly continuous SO_2, in this section of Tampa would be extremely useful in evaluating air quality in Tampa. The Palma Ceia Country Club could provide an excellent location.

g) HCEPC No. 29 - MacDill AFB, SAROAD 10-4360-034
(Source-Oriented)

HCEPC local site 29 is on the southeastern end of Tampa's Interbay peninsula. MacDill AFB, the Tampa Electric Company power plants, and the USPP Gardinier complex constitute the major source influences at this receptor. Sulfur dioxide emissions from TECO's Big Bend station and the Gardinier complex, which are about 5 miles to the southeast and northeast, respectively, should contribute most to SO_2 air quality. Particulate emissions from activities at MacDill AFB are expected to have the most significant impact on TSP air quality.

Sampling for TSP and SO_2 using the hi-vol and West-Gaeke methods has been conducted since 1968 and 1969, respectively, and 24-hour samples have been collected with the federal reference methods once every 6 days since 1972. On February 1, 1973, the samplers were moved about 250 yards south, but the sampler intake elevations remained the same, i.e., approximately 4 to 6 feet aboveground. Although local activity is minimal, the samplers should be elevated to 10 or 15 feet to provide more representative source-oriented data. The SO_2 sampling train was refrigerated on July 17, 1976.

On August 13, 1976, FSOS installed a continuous (pulsed UV-fluorescent) SO_2 monitor inside the sewage treatment plant office. The inlet probe, about 25 feet high, is approximately 100 yards east of the intermittent station. Measurements made before the hydrocarbon cutter was installed on the instrument are expected to be unreliable.

h) HCEPC No. 47 - Keystone Park, SAROAD 10-1800-017 (Background-TSP)

HCEPC site 47, which lies 15 miles northwest of Tampa's city center, is surrounded by a rural-agricultural area and is the background site for TSP in the county network. TSP measurements have been made since 1968 and on a 6-day schedule since 1972.

The sampler is located at ground level (inlet, 4 feet) behind the park meeting center on a cement walk. The area surrounding the sampler is paved or grassed. Moderately traveled Gunn Highway is about 150 yards east of the sampler. The meeting center, a 1-story building, seriously obstructs airflow in the south and west quadrants. Trees surrounding the park cause unavoidable obstructions on the north side.

The sampler is susceptible to local fugitive interferences from agricultural activities, primarily citrus, and an area combustion source (grove heating) during winter freezes; highest TSP loadings occur during these freezes, which also provide ideal conditions for accumulation of air pollutants. The sampler should be moved away from the adjacent building and elevated to at least 15 feet. During relocation, however, care should be taken to prevent interference from park activities and vandalism.

i) HCEPC No. 50 - Sun City Water Plant, SAROAD 10-1800-019 (Population-Oriented)

The major influences on air quality at HCEPC site 50, which is located at the water plant on the eastern border of the Sun City center 5.5 miles east of Ruskin and 18 miles southeast of the Tampa City center, are probably local. The phosphate district near the Hillsborough-Polk line is approximately 18-20 miles east and northeast of the site. The site is roughly located between two large power generating stations: Tampa Electric's Big Bend facility, which is 8 miles northwest; and the new FP&L Manatee plant, which is 6 miles southeast.

Since 1968 at this site, 24-hour TSP samples have been collected. On September 19, 1973, the sampler inlet was elevated to 20 feet aboveground to minimize the influence of water-plant activities. The annual geometric mean TSP concentration has remained fairly constant (29-37 micrograms per cubic meter) since 1972.

This site, located as it is in the closest major populated area to the Ft. Lonesome-Big Four phosphate production area, could serve as an excellent indicator of the industry expansion, although the distances are great. Because of the proximity of two very large power plants and planned increased phosphate production activities in the east, 24-hour SO_2 measurement should be strongly considered at this site.

j) HCEPC No. 51 - Tampa Airport Maintenance Yard, SAROAD 10-4360-006 (Source-Oriented)

Since 1968, total suspended particulate data have been collected with the hi-vol sampling method at site 51, which is located within a fenced compound used to store earth-moving equipment in the maintenance yard of the Tampa International Airport. A 6-day schedule has been followed since 1972. The impact of the active industrial center of Tampa is approximately 8 miles to the southeast. Point source impact at this receptor is expected to be much lower than fugitive sources. The airport, which is 0.25 mile west, is very active and may constitute a significant area source, but localized fugitive sources are expected to provide the greatest impact at this sampling location. A number of graders, dump trucks, and bulldozers are parked near the sampler. The surface is not paved or grass-covered and therefore constitutes a significant fugitive dust source. Although the equipment is not often moved (and, when moved, travels at a very slow speed), the impact from this very close fugitive source may be the predominant influence at this sampling site.

In March 1973, the sampler inlet was elevated from 3 to 14 feet aboveground. This change in location bias decreased the geometric mean; however, maximum concentrations approaching or exceeding the secondary standard were recorded in 1973. This has not been repeated since.

k) HCEPC No. 54 - Big Bend Rd. Maintenance Unit, SAROAD 10-1800-021 (Source-Oriented)

The most important point source influence on air quality at HCEPC site 54, which is at the county maintenance garage on Big Bend Road 12 miles southeast of Tampa's city center, is TECO's Big Bend power generating plant 2.5 miles to the west. Another major source of TSP, SO_2, and other contaminants is the Gardinier phosphate complex 5 miles northwest. When analyzing the TSP data, there is difficulty in separating the contributions of these point sources from localized interference resulting from the operation of the county facility.

TSP measurements have been collected since 1969 and on a 6-day schedule since 1972. During 1972, sampling was suspended for most of the year and only 11 measurements were made. The 24-hour SO_2 monitoring, also on a 6-day schedule, was begun in 1976. The SO_2 sampling system has been refrigerated since September 3, 1976.

The samplers are within the maintenance yard within a few feet of the employees' parking area; Big Bend Road, with moderate traffic, is approximately 50 feet south. On June 18, 1975, the TSP sampler was elevated to 10 feet to minimize interference from local activity within the compound. The SO_2 inlet is 12 feet aboveground. The present configuration offers excellent exposure for three quadrants — south, east, and west — but even so, interference from local activity is not totally eliminated. The north quadrant airflow is partially obstructed by the garage/office and medium-sized trees.

TSP loadings at this station have remained relatively constant since 1972 (geometric mean, 40 micrograms per cubic meter), while the maximum observed 24-hour measurements have dropped sharply since elevation of the sampler inlet. SO_2 measurements have shown at least one exceedence of the 24-hour standard since refrigeration of the sampler.

l) HCEPC No. 55 - Progress Village Sewage Plant, SAROAD 10-1800-022 (Source-Oriented)

Heavy commercial and industrial activities within a 5-mile radius provide the major contributions to TSP and SO_2 air quality in the vicinity of HCEPC site 55, which is approximately 7 miles southeast of Tampa's city center. TECO's Gannon Station and the Gardinier phosphate complex 3.5 miles northwest and 3.5 miles southeast of the sampler, respectively, are major point sources for both particulates and SO_2. A major source of fugitive particulates is Florida Steel Corporation 4.5 miles north.

TSP measurements at this site began in 1969, and a 6-day schedule has been in use since 1972. The sampler is on a cement platform within the treatment plant compound, with the inlet height approximately 8 feet aboveground. The surrounding area is grass, and a dirt drive is 20 feet south of the sampler. The sewage plant is virtually unmanned, so local fugitive interferences associated with activities within the compound are minimal. Although there are large trees within 200 yards on the west and south sides, sampler exposure is good.

m) HCEPC No. 63 - Davis Islands Coast Guard Station, SAROAD 10-4360-035 (Source-Oriented)

HCEPC site 63, located on the east side of Davis Islands at the Coast Guard yacht basin, is within 1 mile (southwest) of the center of Tampa and less than 0.5 mile from heavily industrialized Hooker's Point. The entire area east and south of the site is industrial and includes TECO power plants Hooker's Point 0.5 mile east and Gannon Station 2 miles southeast, Florida Portland Cement 0.5 mile east, and other facilities such as storage and loading associated with port activities.

The state's DER air sampling trailer is operated by the county at this site to continuously monitor SO_2 (coulometric), ozone (chemiluminescent), and hydrocarbons (total and methane, flame ionization). Total sulfur data are also available although, as discussed elsewhere, the validity is questionable. The continuous coulometric SO_2 measurements with the Beckman 906A began in June 1974. In addition, 24-hour SO_2 and TSP measurements using the federal reference methods have been made on a 6-day schedule since 1972. Prior measurements of these two parameters with the ASTM hi-vol and West-Gaeke methods extend back to 1968. The 24-hour samplers have been moved twice. On March 10, 1973, both the TSP and SO_2 systems were moved 100 yards north to the roof of the playground storage shed (inlet elevation, 15 feet). On January 1, 1976, the SO_2 bubbler train was moved to the inside of the FDER trailer very near the original location in order to keep the temperature below 25°C. The SO_2 system is attached to the trailer sampling manifold; inlet elevation is 15 feet. The Coast Guard station, a 2-story building, is the only major obstruction to both receptors in the northeast direction.

The parking area at the yacht basin is not paved and experiences a fair amount of activity during special events (baseball games, etc) at the adjacent playground. Differentiating the impact of this obvious local fugitive interference from industrial sources is difficult since many source changes diminishing industrial fugitive particulates also occurred after the TSP sampler was elevated. Probably for both reasons, the annual geometric mean and the 24-hour maximum TSP observations have shown a yearly decline since 1972.

n) HCEPC No. 64 - Rio Vista Trailer Park, SAROAD 10-1800-54 (Source-Oriented)

HCEPC station 64 was established in 1973 to provide additional information in the vicinity of the Gardinier chemical manufacturing complex, a source of sulfur dioxide, particulates, and fluorides, located approximately 0.8 miles west. TECO power-generating facilities Gannon and Big Bend were 4 miles northwest and 5 miles south-southwest. From late 1973 until the site was discontinued in September 1976, intermittent sulfur dioxide observations were made on a 6-day schedule.

The sampling inlet, located at a height of about 10 feet, was severely obstructed by branches of large trees between the sampler and Gardinier. Other obstructions in other directions were caused by trees, adjacent trailers, and buildings. The effect of these obstructions and the resultant limited probe exposure would have been to bias the measurements low. Concentrations much higher than those actually measured were probable but were not recorded because of the limited exposure and sample decay inherent in the non-temperature-controlled reference method.

At this time, there are no HCEPC SO_2 receptors in the immediate vicinity of the Gardinier complex, an important source of SO_2 in Hillsborough County. HCEPC has recommended that installation of a more suitable site in the area be strongly considered.

o) HCEPC No. 81 - 906 Jackson St., SAROAD 10-4360-021 (Source-Oriented)

HCEPC site 81 was the former laboratory site located in the center of downtown Tampa at 906 Jackson Street. Since the site was only one block west of the Health Department, source influences were identical to those described for HCEPC site 1. However, TSP and SO_2 measurements were much more representative of ground-level exposures than those at site 1 because sampling inlets were much lower.

Intensive sampling for SO_2 and TSP at site 81 began in early 1973; limited continuous SO_2 data were available prior to 1973, but malfunctions plagued the instrument and calibrations were infrequent.

Both 24-hour and continuous SO_2 inlets were about 10 feet aboveground on the south side of and 5 feet out from the building wall. The lab building itself totally obstructed airflow from the north. Other structures to the south also inhibited receptor exposure. All SO_2 sources are south of the site.

The TSP sampler was initially at ground level (inlet, 4 feet) about 50 feet north of the building. Exposure was very poor, and the effects of localized fugitive particulates may have been significant. In the first quarter of 1974, the TSP sampler was moved to the building roof, where inlet height was approximately 30 feet. Exposure here was excellent in all directions.

During 1973 and 1974, intermittent SO_2 and TSP samples were collected each third day. During 1975, the frequency was increased to daily (8 a.m. to 8 a.m.) for TSP and to every other day for SO_2. Annual averages determined from measurements at this site, subject to method limitations, should be very reliable as a result of this high sampling frequency. This frequency was attempted again during 1976, but large gaps in the data occurred because of operational problems. In December 1976, the Beckman 906A continuous SO_2 monitor was replaced with the EPA-equivalent Phillips 9755. SO_2 sampling was suspended on February 2, 1977.

p) HCEPC No. 82 - Orient Rd. Maintenance Unit, SAROAD
10-4360-018 (Source-Oriented)

Total suspended particulate samples have been collected on a 6-day schedule since 1972 and measurements are available from May 1971 at HCEPC site 82, which is located within the county maintenance center on Orient Rd. 5 miles east of the city center. The east Tampa industrial area probably exerts some influence on the air quality in this area, but local commercial and industrial activities constitute the most significant impact on the site. Florida Steel Corporation, a major source of particulates, is approximately 200 yards west of the sampler. Other sources in the immediate vicinity include the David Joseph Box Car Incinerating Company (west), a ready-mix concrete plant (north), and numerous smaller industrial and commercial concerns.

Before March 1972, the sampler was at ground level (inlet, 4 feet) behind the maintenance garage and office, which afforded very poor exposure to the east and south and partial obstruction of airflow from the direction of the Florida Steel plant. The configuration was also very susceptible to localized fugitive interference resulting from activities within the maintenance compound. In March 1972, the sampler was elevated to the roof of the grease garage in the center of the compound, with inlet height of about 30 feet. The present configuration offers excellent exposure in all directions, and the inlet height should minimize localized effects.

Observed TSP values remained very high, even after elevation of the sampler, although maximum 24-hour levels declined during 1975 and 1976. High values usually occur with westerly winds, indicating the Florida Steel plant's very strong influence on this receptor.

q) HCEPC No. 91 - 301 E. 7th Ave., Tampa, SAROAD 10-4360-020 (Population-Oriented)

HCEPC site 91, which was within a few hundred yards of the intersection of Interstate Highways 75 and 4, was 0.5 mile north of downtown Tampa and approximately 1 mile due north of HCEPC sites 1 and 81, so the same source influences (with slightly greater dilution) influenced this receptor.

From 1972 through 1974, 24-hour sampling for SO_2 and NO_2 was conducted on a 6-day schedule. Initially, the sampler was located on the roof of St. Elizabeth's Hospital, where inlet height was more than 50 feet; at this height, exposure was excellent but ground-level concentration was not represented in the data. On July 21, 1973, the sampler was moved south across the street to the Henderson School building, where the sampling probe was attached to the roof at an inlet height of approximately 20 feet. Partial obstruction north was caused by an adjacent building section one story higher, but exposure in other directions was excellent.

r) HCEPC No. 92 - Intersection of Highways 41 and 60, SAROAD 10-1800-064 (Source-Oriented)

HCEPC site 92 at the intersection of Highways 41 and 60 is 3 miles east of the Tampa city center. The nearest point source, the municipal incinerator, is about 1 mile west on Highway 60. Other major sources of SO_2 and TSP that may influence air quality at this receptor are TECO's Gannon plant 5.5 miles south-southwest, the Hooker's Point industrial area 2.5 miles southwest, and the smaller group of industrial-commercial activities that surround the site. In addition, both Highways 60 and 41 are heavily traveled and probably constitute a significant source of fugitive particulates.

TSP and SO_2 sampling on a 6-day schedule began in 1972. Initially, the samplers were 0.5 mile south of Highway 60 on the roof of the Hillsborough auto inspection headquarters on Highway 41; the sampler inlet elevation was approximately 15 feet, and exposure in all directions was excellent. On January 29, 1974, the samplers were moved to their present location atop the Chevron service station on the northwest corner of the intersection; sampler inlets are about 200 feet from the intersection center at a height of about 20 feet, and exposure is again excellent in all directions. Since the change, both the annual geometric mean and the 24-hour TSP maximum have risen but SO_2 values have dropped.

s) HCEPC No. 93 - ICWU-Union Hall, SAROAD 10-1800-066 (Source-Oriented)

HCEPC site 93 on Highway 41 south is about 4 miles southeast of the Tampa city center. Producing significant impacts on the air quality in the area are particulate and sulfur dioxide emissions from the Gardinier phosphate complex about 2.5 miles to the south-southwest and the TECO Gannon and Hooker's Point power-generating facilities 1.5 and 3.5 miles to the northwest. Smaller particulate sources are grouped at the Black Point industrial area 1.5 miles to the northwest; this includes ship-loading facilities and the IMC phosphate rock-drying plant. A number of commercial and small industrial activities surround the receptor and produce a fugitive influence on the air quality.

Since 1972, there have been 24-hour TSP and SO_2 observations on a 6-day schedule at this site. Initially, the samplers were at ground level about 25 feet north of the ICWU Hall in an area surrounded by grass. TSP and SO_2 probe inlets were 4 and 8 feet. The building on the south and trees on the north obstructed airflow from both directions, so the samplers were moved to the roof of the Union building (inlet heights, about 15 feet) on April 24, 1973. At their present location, the samplers experience excellent exposure in all directions; annual geometric mean and maximum 24-hour observations have dropped, indicating that previous measurements at ground level experienced a localized fugitive interference.

t) HCEPC No. 95 - Gibsonton, South Alafia River, SAROAD 10-1800-065 (Source-Oriented)

At HCEPC site 95 on Ohio Avenue east of Highway 41 in Gibsonton, 24-hour SO_2 observations were begun in August 1972 on a 6-day schedule and sampling was discontinued in June 1976. A major SO_2 source was the USPP Gardinier phosphate complex about 1 mile northwest. Other SO_2 sources include TECO's Gannon plant 4.5 miles northwest and the Big Bend facility about 4.5 miles south-southwest.

The sampler was located next to a storage shed on a private residence about 50 feet from the river shoreline. The probe height was elevated from 5 feet to 10 feet in February 1973. A number of large trees were south and west of the site, and single- and 2-story residences were west and east, respectively, as close as 30 feet. Thus, exposure was severely limited in all directions, negatively biasing the measurements.

u) HCEPC No. 103 - 22nd St. Fire Station, SAROAD 10-4360-024 (Source-Oriented)

HCEPC site 103 at 311 S. 22nd Street is about 1 mile east of Tampa's city center. Approximately 0.5-mile south-southwest lies the Hooker's Point industrial complex, where there is a large number of point and fugitive sources of SO_2 and TSP, including a TECO power-generating station and the Florida Portland Cement plant. TECO's Gannon facility is approximately 1.5 miles south of the sampler. Other activities associated with Tampa's port operation are within 0.5-mile west and south.

Initially, 24-hour SO_2 and TSP measurements were made on a 6-day schedule at the Bayside School about 0.25-mile south of the present site; sampling inlets were 4 feet aboveground, and exposure was very poor because a hedgerow and the school building severely obstructed airflow. In January 1973, the samplers were moved to the present location and the sampling inlets elevated to approximately 20 feet. Although a section of the building about 15 feet east of the TSP sampler obstructs airflow and a number of large trees and houses adjacent to the site in all direction could inhibit good ventilation, the location is probably the best available in this area. Measurements at both locations can be expected to suffer negative bias because of inadequate exposure.

6) CF Industries (CF Industries 1976)

CF Industries is monitoring air quality to determine existing concentrations of three air pollutants: sulfur dioxide, total suspended particulates, and fluorides. Attention is confined to these three contaminants as a result of knowledge of the typical major emission sources at an operational phosphate mining/fertilizer production complex of the type being planned for Hardee County; the three pollutants should constitute by far the majority of total emissions, although there will certainly be minor emissions of such contaminants as carbon monoxide, nitrogen oxide, and hydrocarbon. The sampling instrumentation was selected on the basis of several factors, paramount of which were compliance with Hardee County requirements and with state and federal regulations, reliability demonstrated in previous field studies, adequacy to measure concentrations as low as those that would be expected in a relatively clean air area, and availability, both in terms of initial purchase and future parts requirements. Sampling frequencies (Table 2.3) were determined on the basis of Hardee County, state, and federal requirements and recommendations.

a) Stationary and Mobile Air Quality Stations

There are eight stationary air quality monitoring stations — C-1, C-2, C-3, C-4, C-5, C-6, C-7, and C-8 (Figure 2.1). At each, a sheet-metal building is used as the instrument shed. The sheds are placed on foundations to prevent excessive corrosion due to contact with the ground and are secured by straps attached to anchoring posts. Each shed is electrically wired since all the instruments require an alternating-current power source, and each is equipped with a thermostatically controlled air conditioner for cooling and with sealable vents or other means of ventilation. Plywood shelves support equipment and act as workbenches to assist the field inspector in his duties. Lighting is provided by an overhead fluorescent lamp. The sheds are checked routinely for leaks, other structural problems, and evidence of vandalism. Routine housekeeping and maintenance, including replacement of air-conditioner filters, insure sheds that are relatively clean and temperatures that are properly controlled.

Because of the remoteness of much of the Hardee County site, it would be extremely costly to provide permanent electrical service to the more remote portions of the site, especially along the southern boundary. Because of this, a mobile sampling unit was designed and constructed and is being utilized for sampling at Stations C-9 through C-13 (Figure 2.1). A heavy-duty weatherized plywood box mounted on a 2-wheel trailer chassis houses the instruments. Instrumentation power is provided by a generator mounted on the trailer and fueled with propane to reduce emissions of interfering contaminants. A heavy-duty exhaust fan thermostatically controls temperature in the instrument housing. The unit is moved from station to station in accordance with a schedule that provides a 24-hour sampling period at each station once every 6 days; movement is frequent enough to insure timely removal of collected samples and inspection of equipment. Generator fuel is added daily and oil changes and other generator maintenance performed periodically. Supplies kept available for the mobile unit include several full tanks of liquid propane and motor oil.

Operating at seven of the permanent air quality stations (C-1, C-2, and C-4 through C-8) are continuous sulfur dioxide (SO_2) monitors (Meloy Laboratories Model SA 185-2 FPD sulfur analyzer requiring as auxiliary equipment a Leeds and Northrup Model H Speedomax strip chart recorder, a tank of relatively pure compressed hydrogen, and a hydrogen regulator valve). In addition, a portable SO_2 calibration unit (Meloy Model CS 10) is used to service all seven units. The Meloy Model SA 185-2 FPD sulfur analyzer performs real-time continuous dry analysis of sulfur compounds in gas mixtures. It uses a flame photometric detection (FPD) technique that involves monitoring the intensity of light emitted by a sulfur species as it passes through a hydrogen-rich flame. The analyzer's high detection specificity and sensitivity is achieved by a special geometrical arrangement of the burner and the use of a 394 nanometer narrow-bandpass filter. A vacuum pump draws sample air into the detector block, and hydrogen is supplied under pressure from a cylinder; both gas streams are regulated to provide stable diffusion flame while minimizing interference from background light produced by the flame. Sulfur molecules are converted to an S_2 radical and, in turn, react with hydrogen from the flame to produce an activated S_2 radical. When the

S_2 radical reverts to a lower energy state, light of a specific wavelength (394 nanometers) is emitted. A narrow-bandpass filter filters the chemiluminescent emission to provide more detection specificity, and a photomultiplier tube (PMT) measures emission intensity; the current output of the PMT is converted to a voltage by an electrometer amplifier, which is used as the instrument output. The analyzer is connected to the strip-chart recorder, which maps the voltage on a logarithmic response scale. Since the recorder uses linear chart paper, a template is used for reducing chart data to actual SO_2 concentrations in parts per million.

The SO_2 units are calibrated routinely every 2 weeks — and more often when deemed necessary. Calibration consists of verifying the 0 point and two calibration points. Zeroing requires that the intake be switched so that air going to the burner chamber first passes through an activated charcoal filter; this eliminates all sulfur gas from the stream, resulting in an output signal of flame background and amplifier noise. The signal is adjusted by front-panel control to read 3.0 millivolts; when a stable (generally $\pm$ 1 millivolt) signal is attained, the system is considered zeroed.

A known SO_2 source (permeation tube in conjunction with an accurately controlled airflow) is used to calibrate the monitor. A concentration of SO_2 is selected from the calibration unit (0.1 ppm) and fed into the apparatus through a span gas inlet; upon stabilization of the output signal, the voltage can be adjusted to place the calibration point anywhere over a large voltage range. In these studies, the output has been adjusted to the output norm given in the owner's manual, i.e., 56 millivolts above 0.

The process of choosing a calibrator output concentration and adjusting the output voltage is repeated for a second point. The entire calibration procedure, using a 0 and two points, takes about 2.5 hours per unit.

During frequent inspections, inlet-line plugging, flowmetering device operation, recorder-paper supply, pen-drive mechanism, and hydrogen tank pressure are checked. Spot measurements are also made of actual line voltage supplied to equipment. Spare parts and maintenance gear for the entire system of seven sites include seven full hydrogen tanks, one gas regulator valve, several rolls of chart paper, a voltmeter, and a small tool kit. Strip charts are torn off every 2 weeks to be dated, identified, and sent on for data reduction. Recorded values are checked routinely during each site visit and unusual results reported immediately to the field manager.

Installed on the roof of each permanent air quality instrument shed and on the mobile unit's instrument shelter is a hi-vol particulate sampler (General Metal Works Model GMWS 2310 Accu-Vol). The hi-vol sampler's parts include filter holder, heavy-duty air blower, mass flow monitor, and weatherized aluminum shelter. A blower draws air into the shelter at a constant flow (40 standard cubic feet per minute, in this case), and suspended particulates are deposited on a filter situated on a filter holder. The concentration of suspended particles in the air is then computed by measuring the mass of collected particulates and the volume of air sampled. The mass is determined by gravimetric analysis.

Particulates are sampled on a rotational basis; no more than three stations operate on the same day, and at least one station operates part of each day of the week. Operation of each station's particulate samplers is initiated approximately 6 days after that station's previous sampling period. After approximately 24 hours of operation, the instrument is stopped and samples are collected.

The hi-vol samplers are checked periodically by measuring flow with an orifice calibrator. A site must be visited as soon as possible after strong winds have occurred in order to insure that units have not been disturbed. Airflow into the hi-vol is constantly being monitored and corrected by a Sierra mass flow controller; therefore, a single-point initial calibration is all that is needed. During calibration, a previously calibrated orifice is affixed to the sampler intake. The static pressure in the chamber beneath the orifice is monitored by a simple U-tube manometer measuring inches of water; by correcting variations of temperature and pressure from standard conditions, airflow for a given static pressure is read from the calibration curve for the orifice. A variable resistor in the mass flow controller is adjusted to give a manometer reading corresponding to the desired flow of air (in this case, 40 standard cubic feet per minute).

Also mounted in each instrument shed and in the mobile unit's instrument shelter are fluoride samplers (Research Appliance Company's Universal), which are operated on the same schedule as that described for the particulate samplers. The principle of fluoride sampling involves absorption of soluble fluorides in a chemical reagent (absorbing solution) and subsequent laboratory analysis for fluoride concentration in the solution. The major components of the sampler include vacuum pump, glass impingers, filter, and sample volume meter. The vacuum pump draws ambient air into the instrument through plastic tubing, and the air is bubbled through distilled water (absorbing solution) in the impinger, where soluble fluoride is absorbed, and then is exhausted through the pump. The exhaust is filtered before leaving the pump to prevent clogging of orifices and to protect continuous flow. After the sampling cycle is completed, the absorption solution is collected and the total airflow volume noted. The sample is then removed to a laboratory for analysis of ambient air fluoride concentrations.

The fluoride bubblers are checked periodically for plugging of inlet lines and the condition of the inlet line filter. At the end of each sampling period, the collected sample and associated flow record are picked up for analysis. Approximately once every month, the critical orifice flow regulators are cleaned. Spare parts for the fluoride bubblers include extra lengths of tubing and impingers in case of breakage or other damage.

At station C-3 and on the mobile unit is a Research Appliance Company sulfur dioxide bubbler, the operation of which is similar to that of the fluoride sampler. Instead of an external glass impinger, a polypropylene bubbler with 2-hole inlet and outlet design is used for sample collection. The air is bubbled through the reagent where available SO_2 is absorbed, is passed through an overflow trap, and is then exhausted. The sample is collected at the end of each sampling period and removed to the laboratory for analysis. The SO_2 bubbler at C-3 was initiated at the same time as that station's hi-vol and fluoride samplers and runs for a 24-hour period every 6 days. The SO_2 bubbler on the mobile unit is also operated at each station, along with particulate and fluoride samplers, one 24-hour period every 6 days.

b) Meteorological Monitoring Stations

Summer thundershowers, generally of a localized nature and occurring over a small area and then dissipating, account for more than one-half of central Florida's annual precipitation. Because of the precipitation in the large Hardee County project area, seven battery-powered raingage stations have been strategically located to monitor rainfall and a mechanical weather station is operating in the north pasture. This location was chosen because the nearest potential air pollution sources that might affect the project site are the fertilizer plants and mining operations in Polk County to the north of Hardee County.

The tipping-bucket raingages (Meteorology Research Model 304) are mounted on 1-inch-diameter steel pipe anchored in the ground by a concrete base. This rainfall collection system consists of an 8-inch-diameter aluminum sleeve 24 inches long, with funnel and screen mounted over a tipping-bucket assembly and clock mechanisms with marking stylus. A measured 7.95 cubic centimeters of water (equal to 1/100 inches) causes the bucket to overbalance and swing to the opposite side and empty its contents onto the ground. A magnet mounted under the bucket passes close to a magnetic switch during the tipping action, momentarily closing the switch; this pulse triggers a step marking-stylus motor, which records the tip on a pressure-sensitive chart mounted on a clock mechanism that keeps it in constant motion and therefore keeps a continuous record of rainfall with time. Although designed to operate relatively unattended for 45 days, each raingage is checked weekly as well as after storms with high winds. Chart paper records are removed at the end of each month, annotated, and sent on for data reduction. During the weekly inspections, proper operation of the timing and tipping-bucket mechanism is verified. Battery power sources (two D-size alkaline batteries) should be replaced every 2 weeks to assure adequate power for proper operation.

The battery-operated mechanical weather station being used is a multiple data system of single-unit design mounted approximately 9 feet aboveground atop a metal tripod anchored to a concrete slab. All information is recorded in rectilinear form on a battery-wound spring-driven strip-chart recorder. Wind direction is sensed by a ball-bearing-mounted, balanced, single-blade, aluminum vane with nose damping. Wind speed is measured by a cup anemometer employing three 4.5-inch-diameter conical aluminum cups placed directly above the directional vane on the center shaft to allow the system to record representative data from one point in space. Average wind speeds may be read easily from the chart gradations or by means of a plastic overlay guide. The temperature sensor is a shielded spiral coil bimetal element. The sensor's dual range can be adjusted in the field (from the outside of the housing) to suit ambient requirements. All data are recorded on pressure-sensitive paper on a continuous basis.

The mechanical weather station is checked weekly. Chart paper supply is adequate for 60 days, but charts are removed every 30 days, annotated, and sent on for data reduction. In addition to chart-paper removal, the station is cleaned and leveled if necessary and the four D-size alkaline batteries replaced every 2 weeks. Wind orientation and temperature readings are periodically checked and, if necessary, the instrument recalibrated.

C. VEGETATIVE FLUORIDES

1. Review of Problems and Regulations

The effects of fluorides on plants and animals in the vicinity of emission sources came under scrutiny in the early 1960s to the extent that the state of Florida began a program in 1963 to analyze the fluoride concentration in pasture grasses (Tessitore 1975). The pastures of concern were being used for hay production or cattle forage. Vegetative fluorides have been associated with the health (fluorosis) of cattle, as well as with citrus and ornamental crop damage (Tessitore 1976, Cross and Ross 1969).

The state designated a fluoride (F) level of 45 parts per million as the limit that could be safely ingested by cattle without harm. This value includes fluorides both in and on the pasture grass.

While emission standards for soluble and gaseous fluorides have been set by the state to minimize the effects of fluorides on vegetation, large individual or combined smaller sources can still raise local vegetative levels above the limits set by the state (DER 1975).

2. Correlation of Vegetative Fluorides to Other Parameters

Although the atmosphere is the medium through which fluorides are transported from their sources to surrounding vegetation, the correlation between observed atmospheric levels and pasture grass levels is tenuous at best, as is illustrated in Figure 2.2. As shown in Figure 2.3., emissions tend to follow ambient air quality trends but fail to correlate well with pasture grass levels. There does appear to be a correlation between seasonal rainfall and pasture grass fluoride levels, however, as indicated in Figure 2.4.

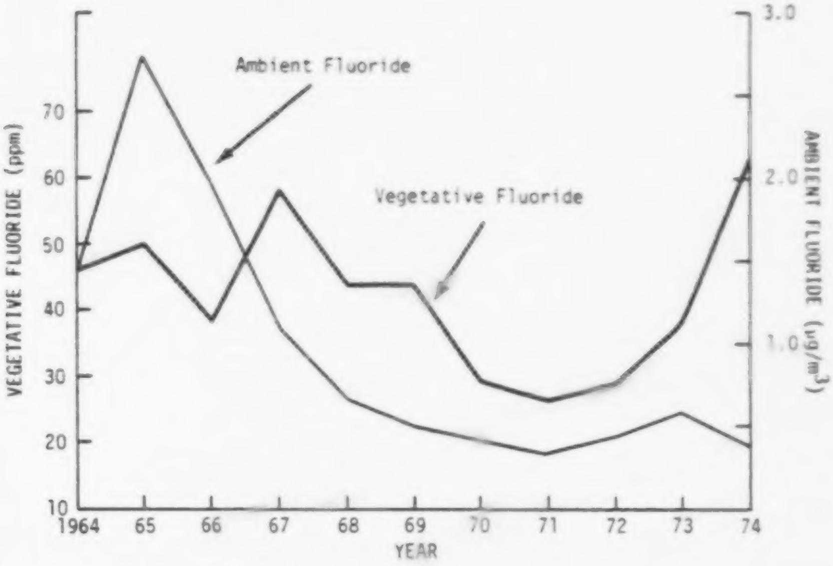


Figure 2.2. Vegetative and Ambient Fluorides in Polk County (Tessitore 1976)

The best correlation inversely relates rainfall to pasture grass levels, as shown in Figure 2.5. Heavy rainfall causes rapid growth of the grass and washes off collected dust that can contain fluorides; the combination of clean grass and a rapid growth rate with a nearly steady assimilation rate of fluorides leads to lower concentrations during periods of heavy rainfall.

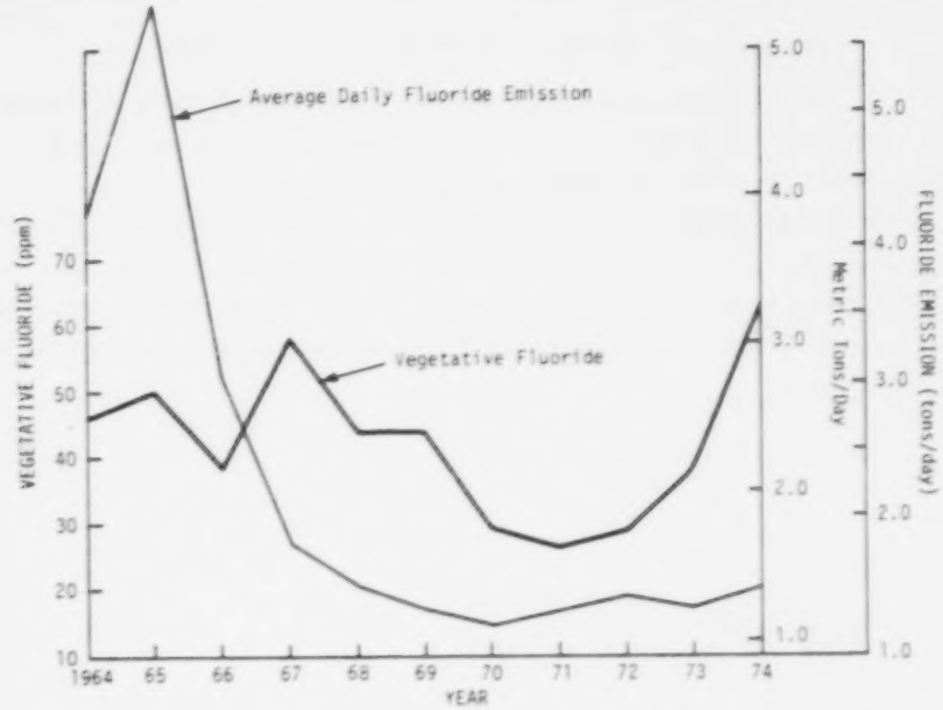


Figure 2.3. Vegetative Fluorides and Average Daily Fluoride Emissions in Polk County (Tessitore 1976)

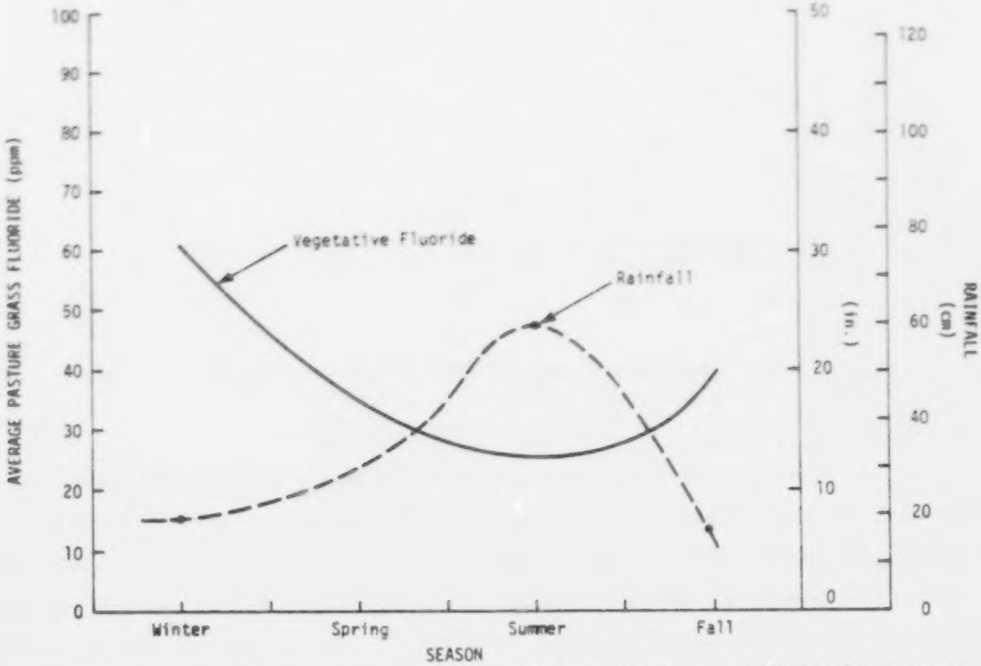


Figure 2.4. Seasonal Fluoride and Rainfall Variation, 1967-74 (Tessitore 1976)

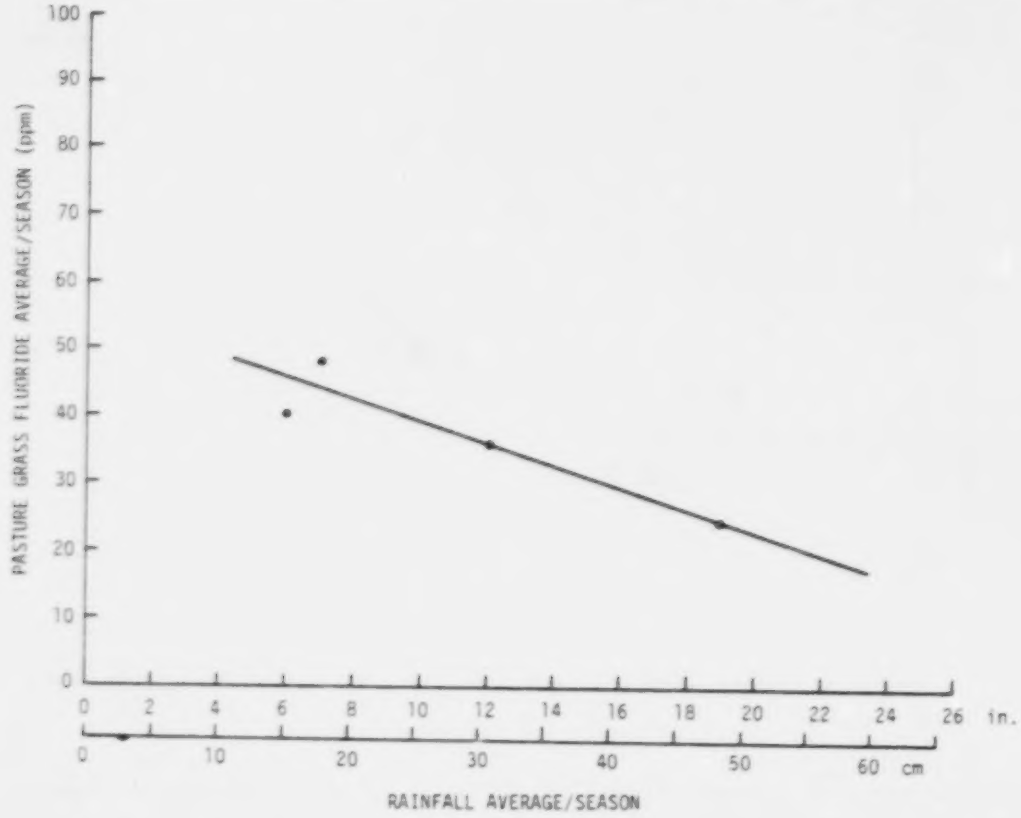


Figure 2.5. Pasture Grass Fluoride Seasonal Average Vs Average Seasonal Rainfall, 1967-74 (Tessitore 1976)

A slight variation on this theme is to relate vegetative fluoride levels to rainfall frequency (Gordon F. Palm & Associates 1976). The average number of days between the last rainfall and the collection of pasture grass samples is shown in Figure 2.6 for part of the normally dry season, January-March.

3. Fluoride Distribution in Polk-Hillsborough County Study Area

Figure 2.2 illustrated that the average pasture grass levels of fluorides in Polk County during 1964-74 varied about a factor of 2; however, variations in the land area exhibiting concentrations of 45 parts per million (ppm) or greater during that time were considerably greater than a factor of 2.

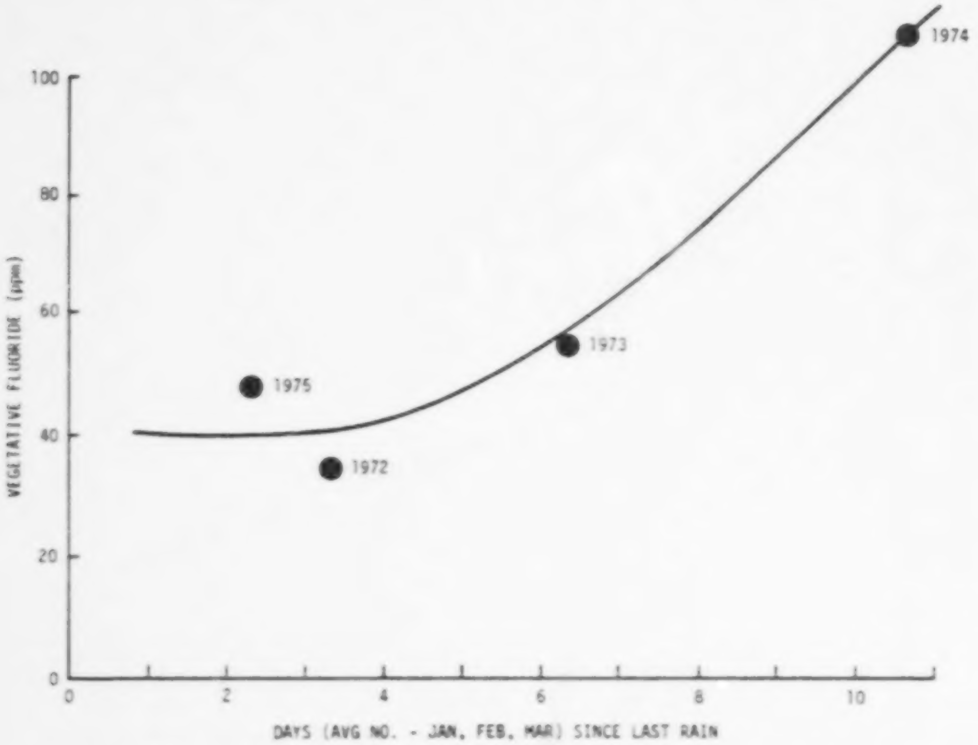


Figure 2.6. Vegetative Fluoride Vs Rainfall Frequency (Gordon F. Palm & Associates 1976)

Figures 2.7 through 2.10 present 45-ppm isopleths based on annual average concentrations at 16 sampling sites in 1966, 1970, 1974, and 1975 (Tessitore 1975). The land area within the 45-ppm isopleth for each year is shown. Except for 1974 which experienced an exceptionally dry winter, there has been a tendency toward smaller areas exceeding the 45-ppm limit. By 1975, the majority of the land included above the 45-ppm value was owned by the phosphate industry.

For about 10 years ending in 1975, pasture grasses around the Borden plant in northwest Manatee County were monitored for fluorides by the Manatee County Pollution Control Department. This program was ended because of a lack of federal research to quantify the effects and set limits for vegetative fluorides and because Borden made an agreement with nearby farmers to purchase "air rights," in effect prepaying local agricultural interests for possible fluoride damage (Manatee 1976).

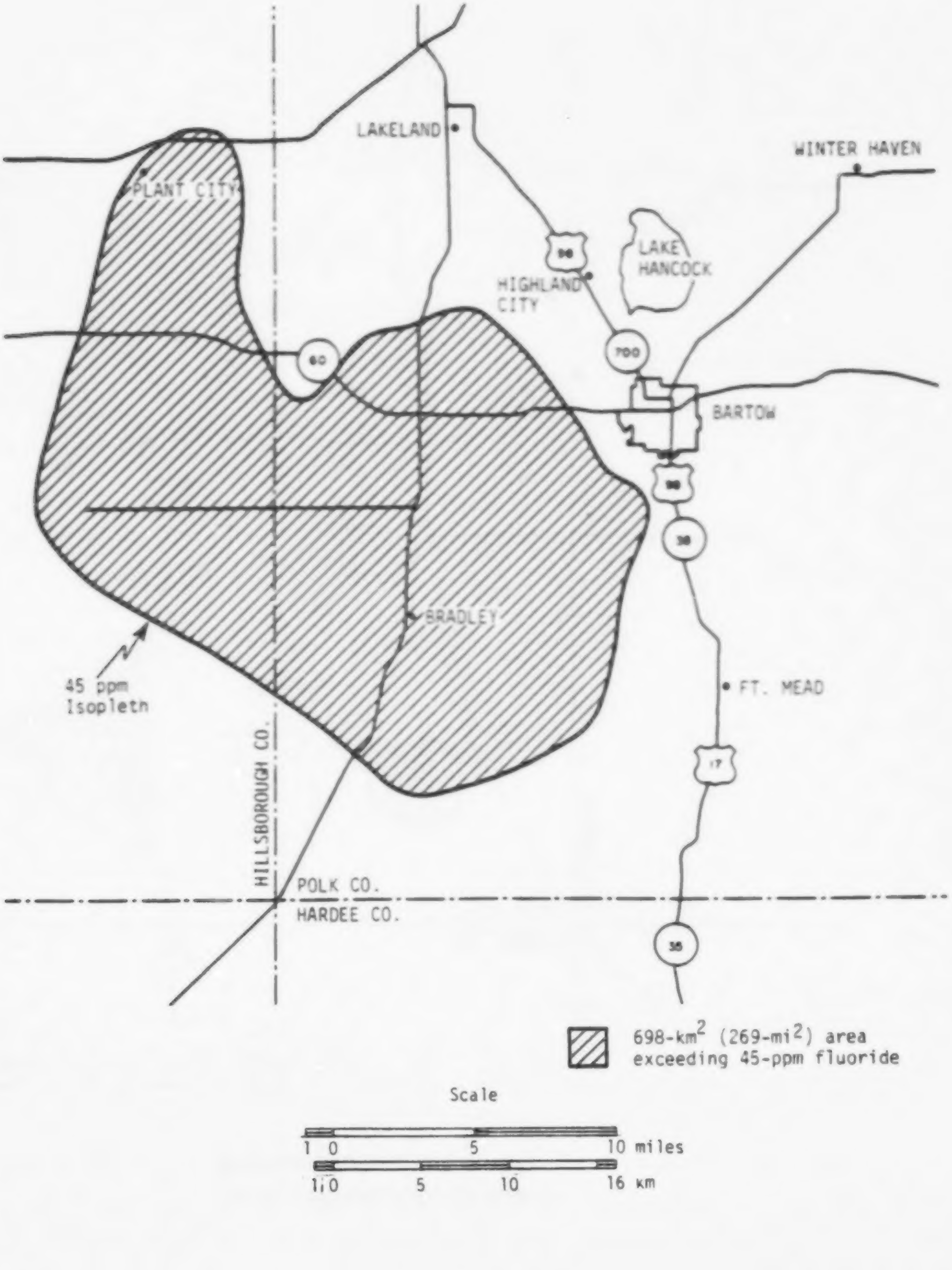

LAKELAND
WINTER HAVEN
PLANT CITY
LAKE HANCOCK
HIGHLAND CITY
98
700
60
BARTOW
98
38
BRADLEY
45 ppm Isopleth
FT. MEAD
17
HILLSBOROUGH CO.
POLK CO.
HARDEE CO.
35
▨ 698-km^2 (269-mi^2) area exceeding 45-ppm fluoride
Scale
1 0 5 10 miles
1 0 5 10 16 km

Figure 2.7. Fluoride Distribution in Pasture Grass, 1966

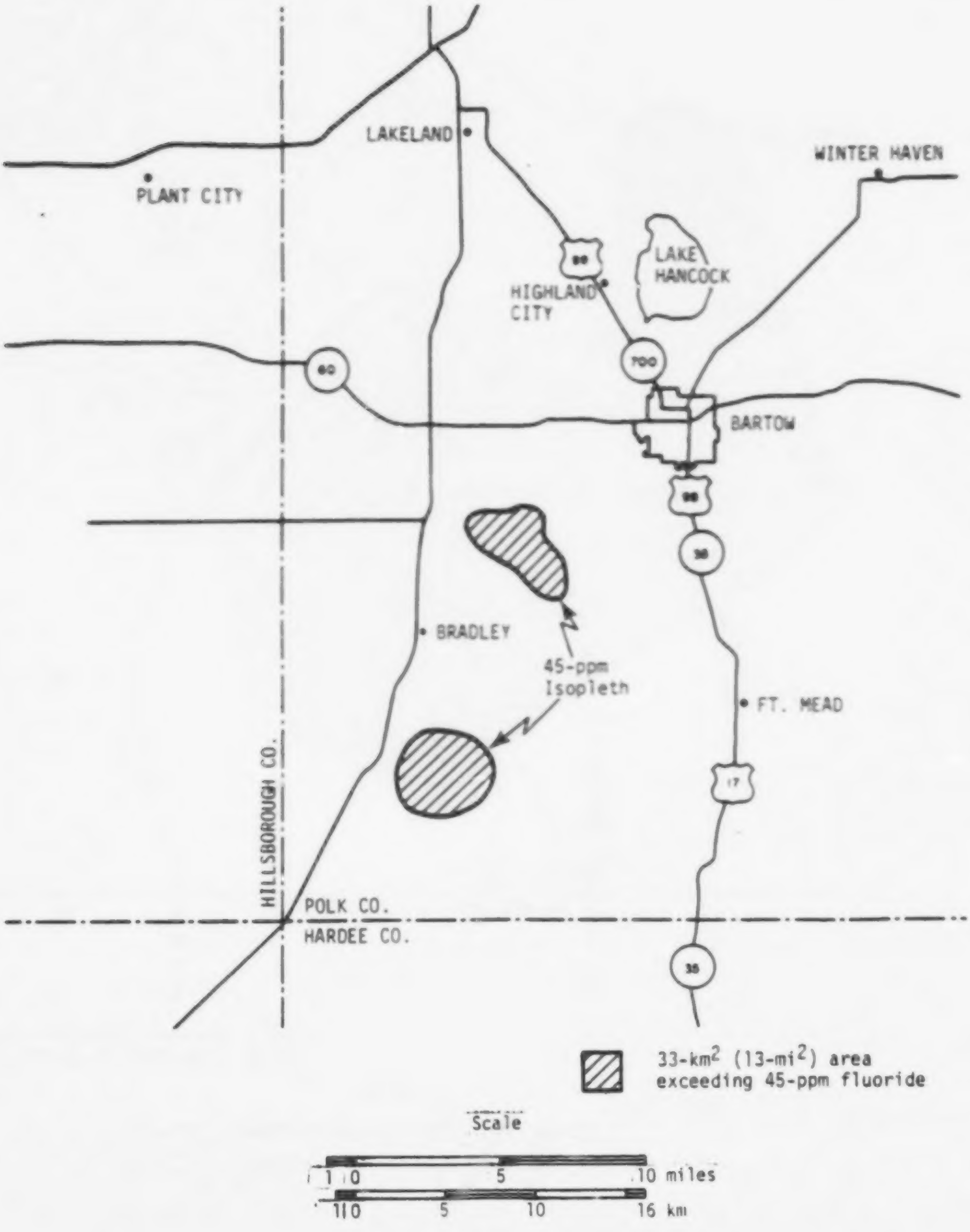

LAKELAND
PLANT CITY
WINTER HAVEN
98
LAKE HANCOCK
HIGHLAND CITY
60
700
BARTOW
98
35
BRADLEY
45-ppm Isopleth
FT. MEAD
17
HILLSBOROUGH CO.
POLK CO.
HARDEE CO.
35
▨ 33-km² (13-mi²) area exceeding 45-ppm fluoride
Scale
0 5 10 miles
0 5 10 16 km

Figure 2.8. Fluoride Distribution in Pasture Grass, 1970

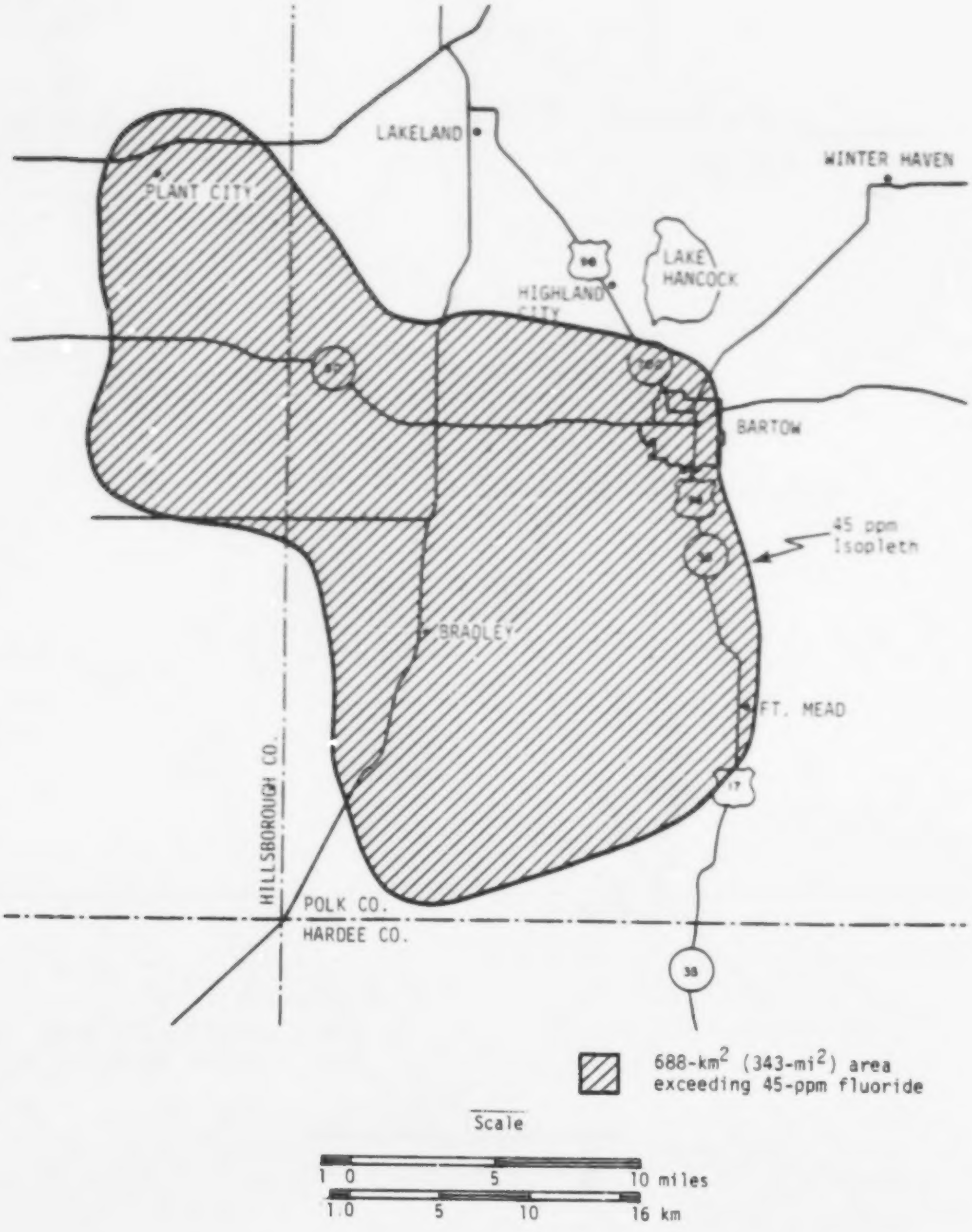

LAKELAND
WINTER HAVEN
PLANT CITY
LAKE HANCOCK
HIGHLAND CITY
BARTOW
45 ppm Isopleth
BRADLEY
FT. MEAD
17
HILLSBOROUGH CO.
POLK CO.
HARDEE CO.
▨ 688-km² (343-mi²) area exceeding 45-ppm fluoride
Scale
1 0 5 10 miles
1.0 5 10 16 km

Figure 2.9. Fluoride Distribution in Pasture Grass, 1974

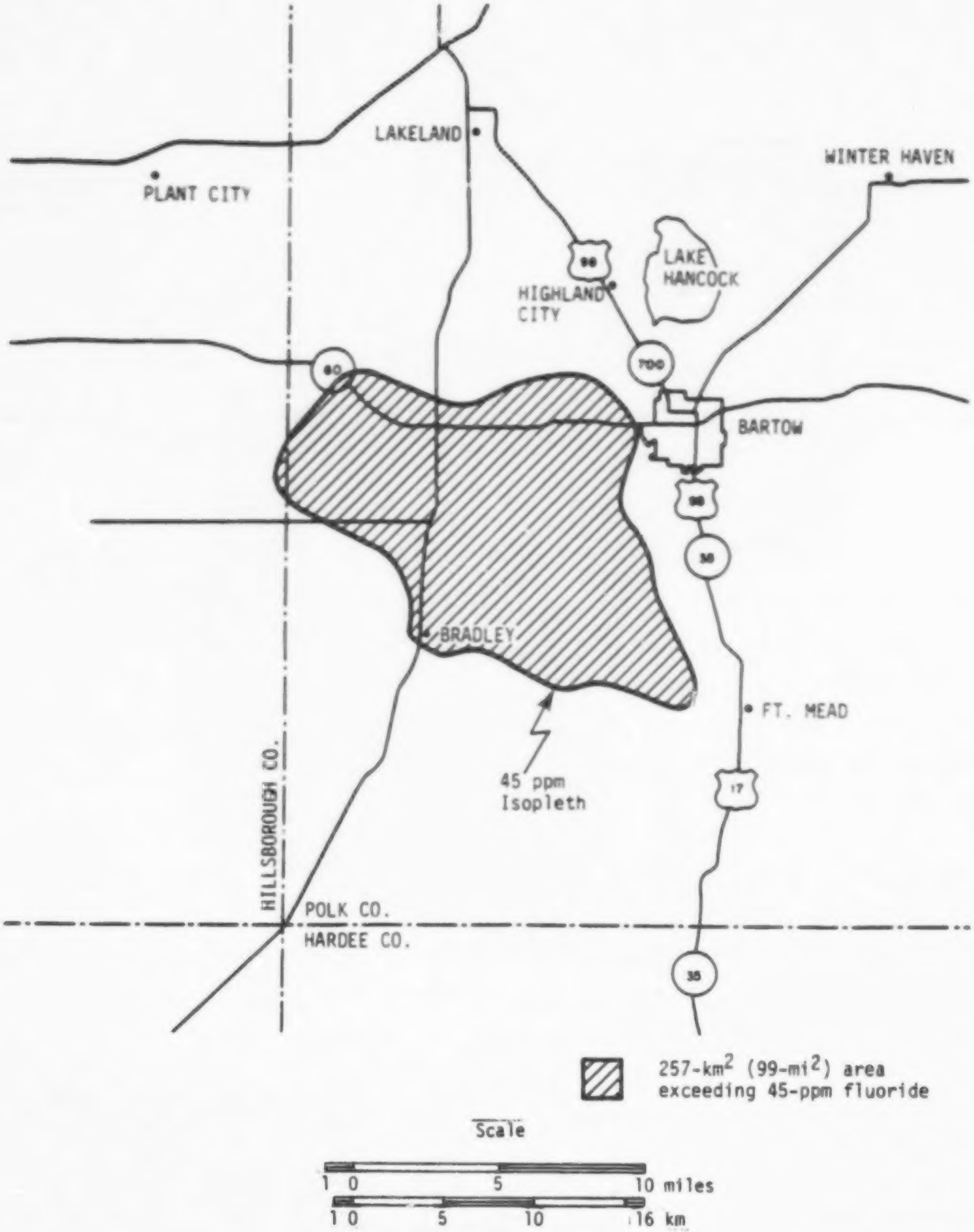

LAKELAND
PLANT CITY
WINTER HAVEN
LAKE HANCOCK
HIGHLAND CITY
98
700
60
BARTOW
98
BRADLEY
FT. MEAD
45 ppm Isopleth
17
HILLSBOROUGH CO.
POLK CO.
HARDEE CO.
35
257-km^2 (99-mi^2) area exceeding 45-ppm fluoride
Scale
1 0
5
10 miles
1 0
5
10
16 km

Figure 2.10. Fluoride Distribution in Pasture Grass, 1975

D. AIR POLLUTION SOURCES

1. Point Sources

a. Distribution and Type

Emissions from the source category classed as point sources are concentrated in Polk, Hillsborough, and Manatee counties. In terms of the quantities of effluents, the major industrial sources are the electric utilities and the phosphate industry. Of the effluents considered in this report, particulates, SO_2, and fluorides are treated in detail with respect to point emissions. Radon, because of its origin and distribution throughout extensive areas, cannot be legitimately associated with discrete discharge points but is discussed further under area sources (Pedco 1976a, DER 1977a).

b. Causes

Within the study area, particulate point sources are associated with the combustion of fossil fuels and with the drying, grinding, and transportation of material containing fine particulates. Only major stationary combustion sources are classified as point sources. Small single-family or apartment heaters and incinerators, mobile sources, and citrus heaters are considered under area sources.

The amount of particulates associated with fossil-fuel combustion varies with fuel type; it is negligible for natural gas and some light fuel oils and increases with heavier grades of fuel oil and coal. Major combustion sources such as electric utilities are equipped with precipitators to remove particulates from the exhaust gases. Small combustion sources generally are uncontrolled with regard to particulate emissions (DER 1977b).

The drying, grinding, and transport of fine particulates can act as point sources of particulate emissions. In addition to such phosphate activities in this category, the production of construction materials is a primary contribution. Various types of air filters minimize emissions from these sources (DER 1977b).

Point sources of SO_2 are associated with the combustion of fossil fuels containing sulfur and the production of sulfuric acid (H_2SO_4). The sulfur content of fossil fuels varies, as does the ash content, with the type of fuel: it is generally negligible in natural gas, ranges up to 2-3 percent in fuel oils, and can exceed 3 percent in coal. SO_2 produced by fuel combustion in the study area is not controlled by scrubbers (EPA 1976b, DER 1977b).

Sulfuric acid production generally involves conversion of pure sulfur into H_2SO_4. The sulfur is burned to form SO_2, which is catalytically oxidized to SO_3 and hydrated to form H_2SO_4 (Hoppe 1976b). Both SO_2 and acid mist are effluents from the process (EPA 1976b).

Both point and area sources of fluoride emissions are associated with the phosphate industry (Tessitore 1975, 1976). Point sources are fertilizer chemical plants, defluorination plants, dryers, grinders, and transfer operations.

Fertilizer processing produces the water-soluble gases hydrogen fluoride (HF) and silicon tetrafluoride (SiF_4) as well as some insoluble fluoride containing particulates. The soluble gases are released in the production of normal and triple superphosphate, normal and superphosphoric acid, diammonium phosphate, and elemental phosphorus. The primary chemical reaction involves sulfuric acid and calcium fluoride:

$$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$$

In the presence of silica, which occurs in the phosphate matrix, a secondary reaction occurs to produce SiF_4:

$$4HF + SiO_2 \rightarrow SiF_4 + 2H_2O$$

The defluorination of phosphate rock to produce animal feed also acts as a source of water-soluble fluoride gases. Defluorination involves heating the rock to 1600°C (2900°F) to drive off fluoride products and reduce the fluoride concentration from 3.5 percent to approximately 0.5 percent.

Phosphate rock drying, which involves heating the rock to 425-650°C (800-1200°F), drives off some soluble gases and particulates containing fluorides. Phosphate rock grinding and transfer points release fluoride containing particulates that are generally insoluble in water.

Water-soluble fluorides are regulated by the state of Florida (DER 1975), and exit gases are scrubbed to reduce effluents to permissible levels. Scrubber water used to remove fluorides is recycled through gypsum and cooling-water ponds at the chemical plants. Gases evolving from the surface of such water bodies can become an area source of fluorides.

c. Information Sources

The 1974 and 1976 point source emissions in the study area are summarized by plant in Appendix C; 1974 represents the base year with which comparisons can be made to determine the effects of regulations and the factors causing the emissions, and the 1976 data are representative of emissions with nearly all sources in compliance with state and federal emission regulations. The primary source of information for 1974 emissions was a Pedco report to the EPA Region IV Air Office (Pedco 1976c, 1976d); it was assumed that 1974 emissions could be approximated by the 1973 data in the report. Since Pedco had covered only Polk and Hillsborough counties (within the study area), additional data were necessary. The Pedco data were supplemented with data from Florida's air emissions file (DER 1977a) and reports on phosphate industry emissions prepared by each phosphate company for the state or the EPA (DER 1976, EPA 1976b). The 1976 inventory was generated using the Pedco 1975 projections as a starting point but updating them with data from the state, Hillsborough County, and EPA Region IV (Pedco 1976c, 1976d; DER 1976, 1977a; EPA 1976b; Shaw 1977).

Existing data on point source emissions were not completely satisfactory for compiling an areawide inventory: there were problems with source identification and emission quantities. Where no data existed or problems with available data could not be resolved satisfactorily, TI contacted the sources directly by phone to resolve the conflicts. The emission inventory presented in this report should be considered a best estimate, since existing reports rather than primary data were the main information sources.

d. Summary

Point source emissions of particulates and SO_2 are summarized by county in Table 2.13. Polk, Hillsborough, and Manatee counties are further broken down to isolate phosphate industry and electric utility emissions. It can be seen that Charlotte, DeSoto, Hardee, and Sarasota counties have had relatively low point source emissions, which are assumed to have been constant from 1974 through 1976. A detailed emission inventory (by plant) is included in Appendix 4.

Table 2.13. Point Source Emission Summary

County	Category /Year		Particulates Metric Tons/Yr	(T/Yr)	SO_2 Metric Tons/Yr	(T/Yr
Charlotte	Misc	74/76	32	(35)	40	(44)
DeSoto	Misc	74/76	29	(32)	85	(93)
Hardee	Misc	74/76	37	(41)	114	(125)
Hillsborough	Phosphate	74	5,279	(5,807)	25,175	(27,692)
		76	2,262	(2,488)	17,875	(19,663)
	Electric	74	20,069	(22,076)	234,823	(258,305)
		76	3,831	(4,214)	213,218	(234,540)
	Misc	74	4,010	(4,411)	7,623	(8,385)
		76	1,816	(1,998)	7,555	(8,311)
	Total	74	29,358	(32,294)	267,620	(294,382)
		76	7,909	(8,700)	238,649	(262,514)
Manatee	Phosphate	74	104	(114)	628	(691)
		76	42	(46)	1,674	(1,841)
	Electric	76	276	(304)	3,801	(4,181)
	Misc	74	295	(325)	118	(130)
		76	295	(325)	118	(130)
	Total	74	399	(439)	746	(821)
		76	614	(675)	5,593	(6,152)
Polk	Phosphate	74	30,033	(33,036)	110,171	(121,188)
		76	6,809	(7,490)	37,149	(40,864)
	Electric	74	204	(224)	7,998	(8,798)
		76	295	(325)	6,987	(7,686)
	Misc	74	889	(978)	841	(925)
		76	1,023	(1,125)	944	(1,038)
	Total	74	31,125	(34,238)	119,010	(130,911)
		76	8,127	(8,940)	45,080	(49,588)
Sarasota	Misc	74/76	115	(126)	175	(192)
County Area	Total	74	61,095	(67,205)	387,789	(421,568)
		76	16,863	(18,549)	289,735	(318,708)

The effect of the phosphate industry in Manatee County was evident in 1974 (one plant operating). During the last 3 months of 1976 when FP&L started one steam generating unit, the steam generating unit and the phosphate plant dominated point source emissions in the county. The steam generating plant will dominate point source emissions in 1977, because Unit 1 will be operational all year and a second unit will start up in the fall.

Hillsborough County point source emissions have been dominated by the power industry in recent years. TECO's three large generating stations on Tampa Bay account for these emissions. The TECO plants reduced particulates from 20,069 metric tons per year in 1974 to 3,831 metric tons per year in 1976 (partially due to installing precipitators). The plants' SO_2 emissions are uncontrolled and depend on the sulfur content of the fuel used. SO_2 emissions were relatively constant from 1974 to 1976, showing a 9 percent reduction in emissions from the generating plants and 11 percent countywide. In 1977 when Gardinier was to have had all of its H_2SO_4 plants in compliance with state emission regulations, phosphate industry SO_2 emissions were to have been considerably reduced (EPA 1976b). In 1977 and beyond, more than 90 percent of SO_2 emissions in the county will be from the power industry, although the phosphate industry will still contribute in excess of 20 percent of the particulate emissions.

In Polk County, the phosphate industry dominates point source emissions; 1976 data attributed more than 80 percent of both particulates and SO_2 to phosphate sources. When Royster's H_2SO_4 plants were brought into source compliance late in 1976, all existing acid plants in the county were operating according to emission regulations. Because of this, SO_2 emissions in the county should have been less in 1977 than in 1976 if the same production levels were maintained. However, the phosphate industry will still be contributing more than 70 percent of the countywide SO_2 emsissions.

Fluoride point source emissions are summarized in Appendix 4 and are not discussed in detail in this section; rather, they will be discussed, along with fluoride area source emissions, under the next topic heading in this volume.

Of the point sources listed in Appendix 3 and summarized in Table 2.13, 49 (listed in Table 2.14) cause more than 90 percent of the particulate and SO_2 emissions. In 1976, these major sources dominated Hardee, Hillsborough, Manatee, Polk, and Sarasota counties, contributing more than 90 percent of the SO_2 in all of the counties listed and more than 90 percent of the particulates in Hillsborough, Polk, and Sarasota counties. By industry classification, the phosphate industry dominated in Polk County in 1976 (more than 80 percent) and electric utilities dominated in Hillsborough and Manatee counties.

Table 2.14. Major Point Sources of Air Pollution in Study Area

Source	Category
Agrico-Pierce	Phosphate
Agrico-S. Pierce	Phosphate
Borden-Piney Point	Phosphate
Borden-Coronet, Plant City	Phosphate
Borden-Tenoroc	Phosphate
Brewster-Brewster Dry Mill	Phosphate
Brewster-Lonesome	Phosphate
CF Chemicals-Bonnie	Phosphate
CF Ind-Plant City	Phosphate
Conserv-Nichols	Phosphate
Electro-Phos-Pierce	Phosphate
Farmland-Green Bay	Phosphate
Gardinier-Tampa	Phosphate
Gardinier-Ft. Meade	Phosphate
W.R. Grace-Bartow	Phosphate
IMC-Bonnie	Phosphate
IMC-Kingsford	Phosphate
IMC-Noralyn	Phosphate
IMC-New Wales	Phosphate
IMC-Port Sutton	Phosphate
IMC-Prairie	Phosphate
Mobil-Nichols	Phosphate
Royster-Mulberry	Phosphate
Swift Chemical-Agricola	Phosphate
USS Agrichem.-Bartow	Phosphate
USS Agrichem.-Ft. Meade	Phosphate
FP&L-Manatee	Electric utility
Lakeland Utilities-Larsen	Electric utility
Lakeland Utilities-No. 3	Electric utility
TECO-Big Bend	Electric utility
TECO-Gannon	Electric utility
TECO-Hookers Pt.	Electric utility
American Orange	Miscellaneous
Ben Hill Griffin	Miscellaneous
C&M Products	Miscellaneous
Citrus World	Miscellaneous
Eastern Assoc. Term.	Miscellaneous
General Portland	Miscellaneous
Gulf Coast Lead	Miscellaneous
Mid-Florida Asphalt	Miscellaneous
Nitram	Miscellaneous
D.S. Prosser	Miscellaneous
Seaboard Coastline Term.	Miscellaneous
Selco	Miscellaneous
Standard Sand & Silica	Miscellaneous
Tampa Incinerator	Miscellaneous
Thatcher Glass	Miscellaneous
Tropicana	Miscellaneous
Warren Bros.	Miscellaneous

Increasing demand for electricity could cause an increase in capacity, which would make the utilities the major point source in all counties directly affected by the generation of electricity.

2. Area Sources

a. Categories

Using a previous emission inventory by Pedco as a guide (Pedco 1975, 1976a), TI has estimated area source emissions of particulates and SO_2 by county. Based on the format prepared by Pedco, TI has estimated area source emissions of particulates by mobile combustion, stationary fuel combustion, open burning, citrus heating, and miscellaneous dust sources. SO_2 emissions are based on mobile, stationary fuel combustion, incineration, and citrus heating sources.

b. Fluoride Source Mechanics

Gypsum and cooling-water ponds associated with phosphate chemical plants are area sources of fluoride emissions. The water in the ponds contains relatively high concentrations of fluorides generated by the manufacture of phosphoric acid and by the scrubber water used to clean various gas streams before they exit the plant. These soluble fluorides are volatile and are transferred to the atmosphere at the pond surface. The problem of evaluating the magnitude of the emissions from the ponds has received some consideration in the past and at this time is not completely resolved (Cross and Ross 1969, Tatera 1970, King and Ferrell 1975, Tessitore 1976, ESE 1977).

c. Radon

Radon-222 is a product of the radioactive decay of uranium-238. Uranium exists with Florida phosphate deposits and is redistributed when the matrix is extracted (Guimond and Windham 1975). In undisturbed ground in central Florida, the uranium is concentrated at or near the phosphate deposits; thus, the surface layers are a shield against radiation and decay products such as radon-222. After being mined, land is no longer composed of the original overburden but of a mixture of overburden and other (formerly deeper) material that carries a higher level of radioactive contamination (Mills et al

1977). Radium-226, the immediate predecessor to radon-222 in the uranium decay scheme, may exist in reclaimed surface and near-surface soils at activity levels up to 10 times those normally found in U.S. surface soils. The radium-226 decays to radon-222, which can diffuse to the surface and collect in surface structures such as houses. Radon-222 also can be found around phosphate rock processing plants having poor ventilation.

d. Summary

Emissions of SO_2, particulates, and fluorides into the atmosphere by phosphate industry sources are regulated by the Florida Department of Environmental Regulation. Extensive use of control devices such as scrubbers, filters, and covered transfer points has drastically reduced emissions by the phosphate industry over the last 5 years. Radon, on the other hand, is generated as a byproduct of industry activities, and neither the full extent of the hazard involved (if any) nor the most effective control methods are known at this time (Guimond and Windham 1975, Mills et al 1977). Studies are underway to evaluate the problem of radiation both in the air and water, but not enough good data exist at this time to fully evaluate either the problem or the potential solutions. A more detailed review of the radiation problem and existing studies concerning this topic appears in Volume VI, Section 4, of the TI baseline study.

1) Particulates and SO_2

Particulates and SO_2 area type emissions in the study area were estimated for 1974 and 1976, using as a guide an area source evaluation by Pedco (Pedco 1975. 1976a). In some cases, the Pedco inventory was extrapolated directly; in other cases, it was used as a reference to generate equations from which to calculate emissions. Annual changes in emissions were based on either the rate of change predicted by Pedco or the annual growth rate implied by the data used in calculations (e.g., population or gasoline sales). The generation of the emission inventory for this report is detailed in Appendix 5. The estimated area source emissions of SO_2 and particulates are tabulated by county in Table 2.15. The following paragraphs briefly describe the methodology employed to generate the data for each category of emission source.

a) Highways

Highway emissions can be related directly to gasoline sales. The correlation was established using Pedco data. Emissions for all counties for 1974 and 1976 were calculated using gasoline sales figures from Thompson (1976).

b) Aircraft

Pedco data were extrapolated to evaluate Polk and Hillsborough county emissions. The only other aircraft emissions considered in this report were from the Sarasota-Bradenton airport; they were credited to Manatee County and were evaluated by correlating Pedco data for Tampa International and Jacksonville International airports with the number and type of air-traffic operations and extending the correlation to Sarasota-Bradenton.

c) Vessels

Vessel emissions for Hillsborough County were extracted from the Pedco inventory which covered Port Tampa. Emissions at Port Manatee and Charlotte Harbor were estimated by obtaining the correlation factor between shipping tonnage and emissions at Port Tampa and extending it to the smaller ports.

d) Railroads

Railroad emissions for Polk and Hillsborough counties were obtained by extending Pedco data. Pedco apportioned the emissions to counties based on the amount of railroad track in each county. Other than Polk and Hillsborough, none of the counties in the study area have extensive railroad networks. Since all of the study-area counties have less track than Pinellas County, the emissions were estimated to be the same as those in Pinellas, which were included in the Pedco inventory.

e) Off-Highway

Polk and Hillsborough county emission estimates were based on Pedco data extended to the remaining counties through development of a correlation relating emission to county population and land devoted to agricultural use.

Table 2.15. Source Emissions [Metric Tons per Year (T/Y)] of Particulates and SO_2 by County (Page 1 of 3)

	Charlotte								DeSoto								Hardee							
	1974				1976				1974				1976				1974				1976			
Source Category	Particulates		SO_2		Particulates		SO_2		Particulates		SO_2		Particulates		SO_2		Particulates		SO_2		Particulates		SO_2	
Mobile Sources																								
Highway	138	(152)	44	(48)	146	(161)	46	(51)	70	(77)	22	(24)	74	(81)	24	(26)	79	(87)	25	(28)	85	(93)	26	(29)
Aircraft	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vessels	3.6	(4)	48	(53)	3.6	(4)	48	(53)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Railroad	1.8	(2)	4.5	(5)	1.8	(2)	45	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)
Off-highway	5.5	(6)	7.3	(8)	6.4	(7)	7.3	(8)	6.4	(7)	4.5	(5)	6.4	(7)	4.5	(5)	6.4	(7)	4.5	(5)	6.4	(7)	4.5	(5)
Stationary Fuel Combustion																								
Natural gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.2	(9)	-	-
Coal	16	(18)	33	(36)	18	(20)	37	(41)	7.3	(8)	15	(16)	7.3	(8)	15	(17)	7.3	(8)	15	(17)	-	-	15	17
Liquid petroleum gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burning																								
Incineration	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)
Forest fires, agriculture	731	(804)	-	-	731	(804)	-	-	572	(629)	-	-	572	(629)	-	-	554	(609)	-	-	544	(609)	-	-
Other Sources																								
Citrus heating	16	(18)	2.7	(3)	16	(18)	2.7	(3)	87	(96)	17	(19)	87	(96)	17	(19)	110	(121)	21	(23)	110	(121)	21	(23)
Fugitive dust	660	(726)	-	-	660	(726)	-	-	764	(840)	-	-	764	(840)	-	-	1,644	(1,808)	-	-	1,644	(1,808)	-	-
Paved roads	259	(285)	-	-	275	(302)	-	-	131	(144)	-	-	139	(153)	-	-	149	(164)	-	-	158	(174)	-	-
Total	1,835	(2,020)	141	(155)	1,862	(2,049)	147	(163)	1,644	(1,808)	65	(71)	1,656	(1,821)	67	(74)	2,556	(2,811)	72	(80)	2,572	(2,828)	73	(81)

Table 2.15. (Page 2 of 3)

	Hillsborough								Manatee							
	1974				1976				1974				1976			
Source Category	Particulates		SO_2		Particulates		SO_2		Particulates		SO_2		Particulates		SO_2	
Mobile Sources																
Highway	2,582	(2,840)	817	(849)	2,739	(3,013)	867	(954)	369	(406)	116	(128)	391	(430)	124	(136)
Aircraft	70	(77)	106	(117)	77	(85)	118	(130)	10	(11)	15	(17)	11	(12)	17	(19)
Vessels	66	(73)	789	(868)	66	(73)	789	(868)	5.4	(6)	67	(74)	5.4	(6)	67	(74)
Railroad	109	(120)	249	(274)	120	(132)	275	(302)	1.8	(2)	4.5	(5)	1.8	(2)	45	(5)
Off-highway	83	(91)	103	(113)	88	(97)	110	(121)	18	(20)	21	(23)	20	(22)	23	(25)
Stationary Fuel Combustion																
Natural gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal	225	(248)	484	(532)	233	(256)	525	(577)	48	(53)	98	(108)	53	(58)	108	(119)
Liquid petroleum gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burning																
Incineration	7.3	(8)	4.5	(5)	7.3	(8)	4.5	(5)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)
Forest fires, agriculture	991	(1,090)	-	-	991	(1,090)	-	-	690	(759)	-	-	690	(759)	-	-
Other Sources																
Citrus heating	45	(50)	6.4	(7)	45	(50)	6.4	(7)	17	(19)	2.7	(3)	17	(19)	2.7	(3)
Fugitive dust	3,353	(3,688)	-	-	3,353	(3,688)	-	-	1,234	(1,357)	-	-	1,234	(1,357)	-	-
Paved roads	4,851	(5,336)	-	-	5,146	(5,661)	-	-	693	(762)	-	-	693	(809)	-	-
Total	12,382	(13,621)	2,559	(2,815)	12,865	(14,153)	2,695	(2,964)	3,091	(3,400)	326	(360)	3,163	(3,479)	348	(383)

Table 2.15. (Page 3 of 3)

	Polk								Sarasota							
	1974				1976				1974				1976			
Source Category	Particulates		SO_2		Particulates		SO_2		Particulates		SO_2		Particulates		SO_2	
Mobile Sources																
Highway	1,121	(1,233)	355	(390)	1,189	(1,308)	376	(414)	514	(565)	163	(179)	545	(599)	173	(190)
Aircraft	3.6	(4)	1.8	(2)	4.5	(5)	2.7	(3)	-	-	-	-	-	-	-	-
Vessels	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Railroad	61	(67)	140	(154)	68	(75)	155	(170)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)
Off-highway	43	(47)	51	(56)	46	(51)	54	(59)	22	(24)	27	(30)	23	(25)	29	(32)
Stationary Fuel Combustion																
Natural gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coal	116	(128)	225	(248)	124	(136)	245	(270)	65	(71)	132	(145)	69	(76)	141	(155)
Liquid petroleum gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burning																
Incineration	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)	4.5	(5)	1.8	(2)
Forest fires, agriculture	1,705	(1,876)	-	-	1,705	(1,876)	-	-	544	(599)	-	-	544	(599)	-	-
Other Sources																
Citrus heating	345	(380)	66	(73)	345	(380)	61	(73)	1.8	(2)	-	-	1.8	(2)	-	-
Fugitive dust	5,478	(6,026)	-	-	5,478	(6,026)	-	-	688	(757)	-	-	688	(757)	-	-
Paved roads	2,106	(2,317)	-	-	2,235	(2,458)	-	-	965	(1,061)	-	-	1,024	(1,126)	-	-
Total	10,983	(12,083)	841	(925)	11,199	(12,320)	901	(991)	2,806	(3,087)	328	(361)	2,901	(2,191)	349	(384)

f) Stationary Fuel Combustion, All Fuel Types

All of the fuel categories delineated by Pedco were combined for presentation in this report. Polk and Hillsborough county estimates were based on Pedco data extended throughout the study area by correlating emissions to county population.

g) Incineration and Open Burning

Polk and Hillsborough emission estimates in this category were based on Pedco data. Emissions in the remaining counties were assumed to be less than or equal to those in Polk County and were tabulated with Polk County estimates.

h) Forest Fires and Open Burning

Polk and Hillsborough county emissions were estimated from Pedco data extended to the remaining counties by relating the land area of the counties to emissions.

i) Citrus Heating

Polk and Hillsborough county estimates were based on Pedco data. Emissions for the remainder of the counties were estimated by first classifying them as inland or coastal and then relating the land area devoted to citrus crops in each county to the emissions.

j) Fugitive Dust

Polk and Hillsborough county estimates were based on Pedco data. Emissions were estimated for the remaining counties by relating the emissions to the miles of unpaved roads and fraction of undeveloped land area.

k) Paved Roads

Dust reentrained by traffic on paved roads can be related to vehicle miles traveled and hence gasoline sales, as was the case for highway emissions. The correlation was established using Pedco data; then, emissions for all counties were calculated using more recent gasoline sales figures (Thompson 1976).

2) Fluoride

In 1975, King and Ferrell (1975) published a paper describing a study to evaluate pond emission rates. While the rates of emission were variable, depending on fluoride concentrations and meteorological conditions, fluoride averaged 0.22 kilogram per metric ton of P_2O_5 produced as wet acid. TI, using rock production rates from Tomasino (1977a), P_2O_5 content from Hoppe (1976a), and the fraction of rock processed by the wet-acid method (Wang et al 1974). estimated total cooling-water pond emissions in Polk, Hillsborough, and Manatee counties. The emissions were apportioned to each county based on the point source fluoride emissions reported to the DER by industry sources within that county (EPA 1976b).

The estimated area source emissions for 1974 and 1976 are summarized in Table 2.16, along with the reported 1976 point source emissions. The area source emissions suggested by these estimates are about five times as great as the reported point source emissions; however, the area source estimates are approximate, i.e., not based on actual measurements such as the stack measurements used to estimate most point source emissions. The estimates show that (1) open pond emissions could quite easily exceed regulated point source emissions and (2) scrubbing fluorides from process gases and subsequently disposing of scrubber water into cooling ponds could simply change the location of the emissions to the atmosphere.

Table 2.16. Summary of Reported Point Source Emissions of Fluorides and Estimates of Area Source Pond Emissions for Polk, Hillsborough, and Manatee Counties

County	Metric Tons Per Year (T/Yr)					
	Pond Emissions 1974		Pond Emissions 1976		Point Sources 1976	
Polk*	1,120	(1,232)	1,211	(1,332)	244	(268)
Hillsborough*	320	(352)	346	(381)	69	(76)
Manatee	15	(16)	15	(17)	2	(2)
Total	1,455	(1,600)	1,573	(1,730)	315	(346)

*Fluoride product recovery at one plant in Polk County and two plants in Hillsborough County would tend to reduce pond emissions. Since no quantitative data exist on the extent of the reduction, it is not reflected in the numbers tabulated.

3. Areawide Summary

Table 2.17 summarizes areawide point and area emission sources of particulates and SO_2 for 1974 and 1976. On an areawide basis, particulate and SO_2 emissions decreased because point source emissions decreased. Area sources showed a slight increase. On an individual county basis, the less industrially developed counties (Charlotte, DeSoto, Hardee, and Sarasota) experienced small increases due primarily to population-oriented area-type emissions. Although area sources in Hillsborough, Manatee, and Polk counties increased slightly, control of point sources contributed to a net decrease in Polk and Hillsborough counties. Manatee's increase was due to a new point source, the FP&L steam generating plant near Parrish.

Table 2.17. Summary of Point and Area Source Emissions in Study Area

	Metric Tons per Year			
	1974		1976	
County	Particulates	SO_2	Particulates	SO_2
Charlotte				
Area sources	1,835	141	1,862	147
Point sources	32	40	32	40
DeSoto				
Area sources	1,644	65	1,656	67
Point sources	29	85	29	85
Hardee				
Area sources	2,556	72	2,572	73
Point sources	37	114	37	114
Hillsborough				
Area sources	12,382	2,559	12,865	2,695
Point sources	29,358	267,620	7,909	238,649
Manatee				
Area sources	3,091	326	3,121	348
Point sources	399	746	614	5,593
Polk				
Area sources	10,983	841	11,199	901
Point sources	31,125	119,010	8,127	45,080
Sarasota				
Area sources	2,806	328	2,901	349
Point sources	115	175	115	175
Total				
Area sources	35,297	4,332	36,176	4,580
Point sources	61,095	387,790	16,863	289,736
All sources	96,392	392,122	53,039	294,316

Particulates were dominated by area sources in 1976, indicating that further improvement in air quality with respect to suspended dust will require extensive effort. The effect of more stringent controls on point sources will not be appreciable in the less developed counties and will be a decreasing one (percentagewise) in Hillsborough, Manatee, and Polk counties as the consequence of newly installed dust collection systems becomes more apparent in 1977.

SO_2 emissions are dominated by point sources, primarily steam generators and phosphate plants. Hillsborough County can apparently expect little decrease in SO_2 emissions unless more low-sulfur fuel is used in the generation of electricity. Manatee County will see a marked increase in SO_2 emissions as the second FP&L unit comes onstream. Because of control systems installed in late 1976, Polk County will experience a decrease in SO_2 emissions in 1977 if the plants (phosphate) operate at the same capacity. The remaining counties in the study area will remain relatively unaffected by point source SO_2 emissions.

The counties that underwent the greatest changes during 1974-76 because of point source controls were Hillsborough, with a reduction of approximately 50 percent in total particulates, and Polk, with both particulates and SO_2 decreasing about 50 percent.

E. SUMMARY

1. Air Quality

The data in this report do not permit a quantitative appraisal of the levels of SO_2 found in the study area. Virtually all of the data reported prior to mid-1976 were collected by 24-hour samplers using some variation of the federal reference method. The thermal degradation of samples, coupled with problems associated with sampling locations and hardware, precluded correcting the existing data to obtain good air quality estimates (Pedco 1976a, Urone and Chadbourne 1977, Bowman 1977). All of the problems just mentioned tended to reduce the values recorded for SO_2, so that the existing data, at best, form the lower limit for conditions that actually existed while samples were being collected. It can be interpreted to mean that the incidents in which SO_2 exceeded state and federal air quality standards in Polk and Hillsborough counties (Table 2.4) were considerably underestimated.

Until better SO_2 data are reported in the study area, the only conclusion that can be drawn is that Polk and Hillsborough counties are the most likely to exceed SO_2 state and federal standards in the area. Beginning in the latter half of 1976, however, the FSOS report and the cooled 24-hour samplers used by HCEPC should have begun to provide a good data base; unfortunately for the purposes of the central Florida phosphate industry areawide impact assessment program, it will be longer before data adequate to characterize the remainder of the study area (other than Hardee County, which is serviced by the CF Industries network of continuous monitors) will be forthcoming. Trends in SO_2 levels can be extracted from the data, however, where the values reported are above the limit of sensitivity for the analytical method (U.S. 1971). The trend shows decreases since 1974 in Polk, Hillsborough, and Manatee counties (Table 2.5) and no significant variations in the average values reported elsewhere. This is consistent with SO_2 levels reported to have been emitted from 1974 to 1976.

TSP data are subject to some problems associated with local effects due to the siting of individual samplers, but the quality of the reported data is generally quite good. State or federal standards were exceeded in four counties from 1972 to mid-1976 (Table 2.9), with the majority of the incidents occurring in Polk and Hillsborough counties. Since 1974, levels in all of the reporting counties have decreased although Polk and Hillsborough still were exceeding state or federal standards in heavily industrialized areas on some occasions in 1976. Samplers in rural areas throughout the study area can be expected to yield high TSP readings occasionally because of traffic on unpaved roads or agricultural activity.

Fluoride data from 1972 to mid-1976 are difficult to interpret. The accuracy of the sampling method has not been clearly established, and the reported readings have generally been so low that interpretation is difficult. There has been a decreasing trend in the highest values reported, although changes in the annual averages have not been significant.

There is no data base on which to evaluate radon-222 levels in the study area. The problem of radiation hazards in general is covered in Volume VI, Section 4, of this series of working papers.

2. Vegetative Fluoride

The levels of vegetative fluoride reported by DER's Westcentral District indicate a general decline from 1966 through 1975 (Tessitore 1975, 1976), but the land area exhibiting pasture grass fluoride content greater than 45 ppm (deemed hazardous to foraging cattle) did not decrease uniformly. The measured fluoride in pasture grass seems to have been related to rainfall frequency; fluoride was observed to have increased during a dry year despite a generally decreasing trend since 1966 (Figure 2.9). By 1975, the majority of the land still exhibiting high pasture grass fluoride levels was owned by the phosphate industry.

3. Emission Inventory

In the point and area source emission data collected for SO_2, particulates, and water-soluble fluorides during 1974 and 1976, the only significant changes occurred in the developed areas of Polk, Hillsborough, and Manatee counties (Table 2.17).

In Manatee County, the change from 1974 to 1976 involved a significant increase in SO_2 emissions because of start-up of the FP&L power plant at Parrish.

In Polk County, controls put on line for point sources resulted in drastic reductions in SO_2 and particulate emissions. Area sources in Polk County showed a slight increase consistent with population-oriented area sources.

Hillsborough County exhibited a marked decrease in particulate emissions and a slight decrease in SO_2, both due to point source controls that have been put into effect since 1974. The change in SO_2 was not very great because the principal point sources of SO_2 in the county are power plants, which base their control of SO_2 emissions only on the sulfur content of the fuel they burn.

Estimates of fluoride point and area sources were handicapped by the unavailability of data. Point source data for 1976 were included in the phosphate industry reports, but no 1974 data were available. Since estimates of area source emissions from gypsum waste and cooling-water ponds during 1974-76 were based primarily on the level of process activity and the emissions were not subject to controls, they were considered to be nearly constant (Table 2.16).

4. State Air Quality Implementation Plan

The counties in the study area that are in the Westcentral Florida Air Quality Control Region are Hillsborough, Polk, Manatee, and Hardee (EPA 1976a). The area is designated Class I for SO_2 and particulates, which means that only small positive increments in the levels of SO_2 and particulates were allowed after January 1, 1975 (EPA 1976a). Sarasota, DeSoto, and Charlotte counties are in the Southwest Florida Intrastate Air Quality Control Region, which is designated Class III for SO_2 and particulates; Class III limits air pollutants to levels set by the national ambient air standards.

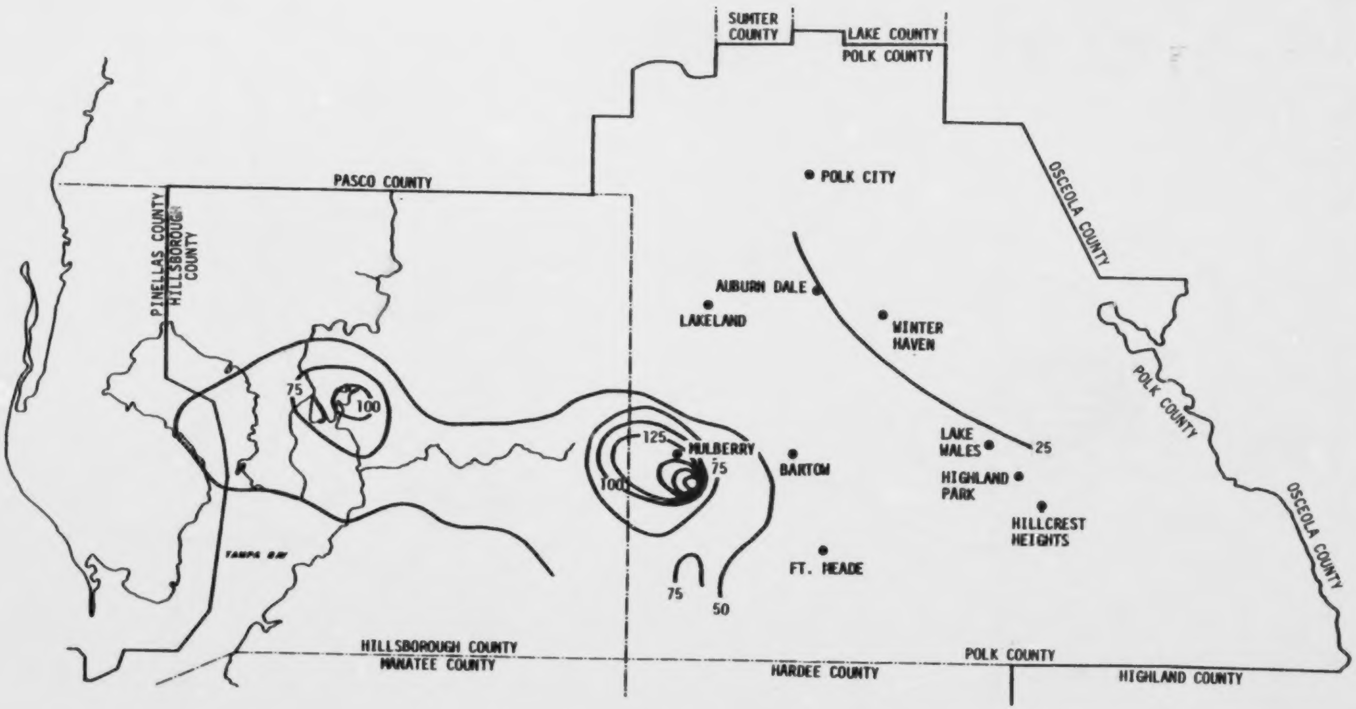
Existing air quality levels of SO_2 indicate a decline in Polk and Hillsborough counties because of point source controls and little change anywhere else except Manatee County where installation of the FP&L Parrish plant has resulted in an increase. Daily emissions from the latter with both units on line in late 1977 were estimated at approximately 80,000 kilograms; if this were dispersed uniformly throughout a mixing volume 1,500 meters deep and 100 kilometers in radius around the plant site, the incremental increase in the ambient level of SO_2 would be almost 2 micrograms per cubic meter, which would be close to exceeding the Class-I limits for the county. Since 1,500 meters is an estimate for the mixing depth in central Florida (Holzworth 1972) and since uniform mixing into a volume as large as that implied by a cylinder 200 kilometers in diameter by 1,500 meters in height is quite unlikely, there is a strong possibility that Manatee County will not be in compliance with the state's air quality implementation plan by the end of 1977.

Particulate concentrations have tended to decrease or remain constant throughout the area since 1974 because of point source controls that have sometimes been offset by increased area source emissions. It appears at this time that the entire area will fall within the requirements concerning incremental increases in particulate loading since 1974, even though some areas may remain above the levels stated in federal and state standards for ambient TSP. The problem areas will be in Polk and Hillsborough counties. Further decreases in particulate levels will be difficult to achieve, since the largest contributions to dust in 1976 in all counties within the study area were made by area sources (Table 2.17) that are difficult to control.

5. Air Quality Modeling

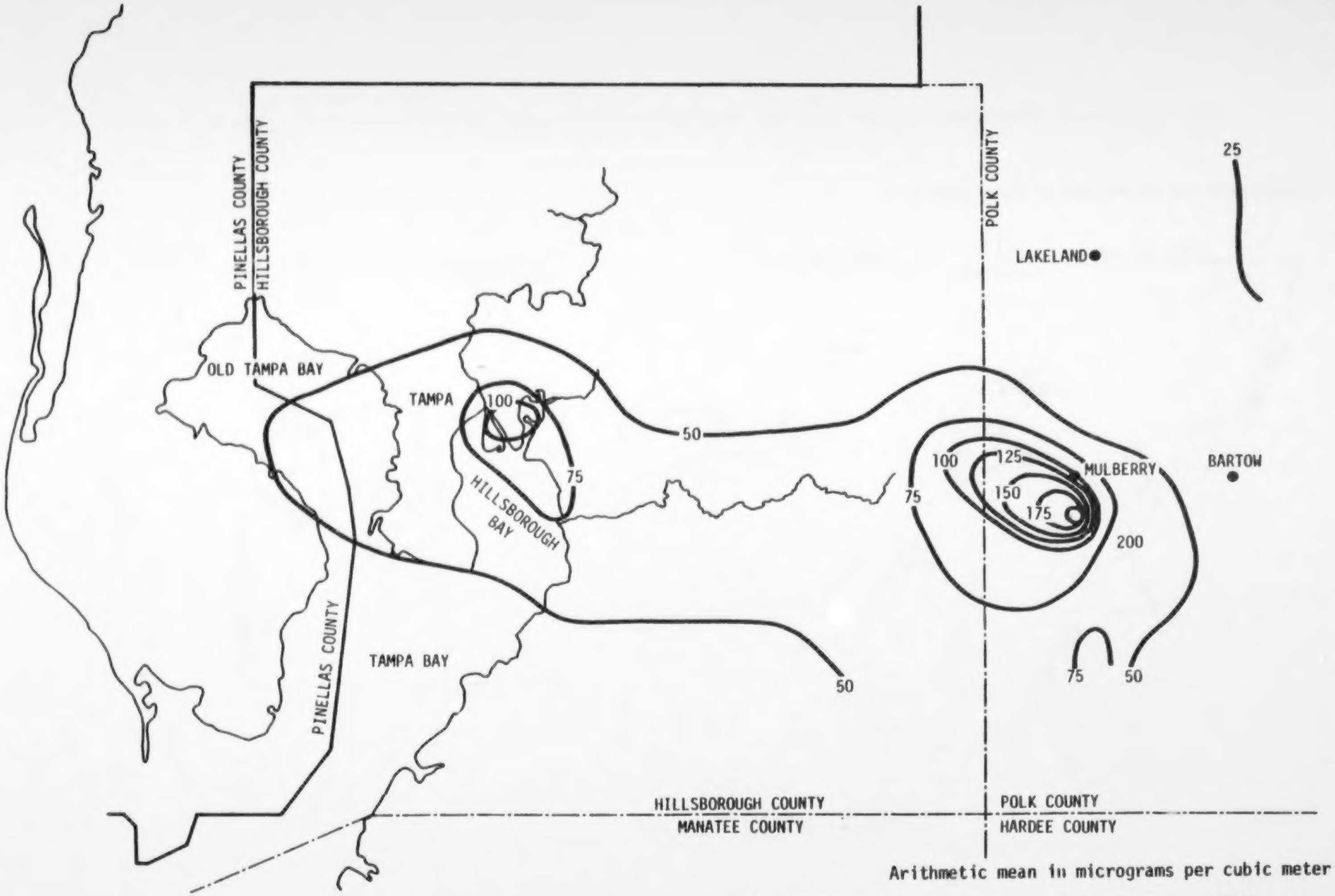
Detailed air quality models have been run in the study area several times for various purposes. Some such modeling studies were included in DRIs recently submitted by phosphate companies to the state. More extensive studies (ESE 1975, Pedco 1976a) were conducted over the Polk-Hillsborough county area for the electric utilities and the EPA (Region IV). The EPA-sponsored study by Pedco developed a detailed point and area source emission inventory of Polk and Hillsborough counties for 1973 and included projections for 1975, 1980, and 1985. The actual modeling used the EPA-approved air quality display model (AQDM). The particulate modeling was calibrated against existing air quality data, and a calibration factor of almost 1.0 was found. This was expected, since dust usually does not dissipate in the air but is transported and eventually settles out. The SO_2 model could not be calibrated with air quality data for reasons discussed earlier in this report; for display purposes, a calibration factor of 0.5 was used, which meant that calculated values were reduced by a factor of 2 to approximate actual expected ground-level concentrations after the SO_2 had reacted with the atmosphere. This calibration factor was chosen because similar work by EPA had indicated that a calibration factor of 0.5 is good in most cases.

In Figure 2.11, particulate concentrations are projected to be highest near the downtown Tampa industrial area and in the middle of the phosphate industry concentration in southwest Polk County. Figure 2.12 showing the particulate distribution in expanded detail indicates


SUMTER COUNTY
LAKE COUNTY
POLK COUNTY
OSCEOLA COUNTY
POLK COUNTY
OSCEOLA COUNTY
PASCO COUNTY
PINELLAS COUNTY
HILLSBOROUGH COUNTY
POLK CITY
AUBURN DALE
LAKELAND
WINTER HAVEN
LAKE WALES
25
HIGHLAND PARK
HILLCREST HEIGHTS
MULBERRY
BARTOW
FT. MEADE
125
100
75
75
50
75
100
TAMPA BAY
HILLSBOROUGH COUNTY
MANATEE COUNTY
HARDEE COUNTY
POLK COUNTY
HIGHLAND COUNTY

Arithmetic mean in micrograms per cubic meter

Figure 2.11. Calculated Particulate Concentrations in Polk and Hillsborough Counties, 1973 (Pedco 1976a)


POLK COUNTY
LAKELAND
25
BARTOW
MULBERRY
100
125
150
175
200
75
50
75
50
PINELLAS COUNTY
HILLSBOROUGH COUNTY
OLD TAMPA BAY
TAMPA
100
75
50
HILLSBOROUGH BAY
TAMPA BAY
PINELLAS COUNTY
50
HILLSBOROUGH COUNTY
MANATEE COUNTY
POLK COUNTY
HARDEE COUNTY

Arithmetic mean in micrograms per cubic meter

Figure 2.12. Calculated Particulate Concentrations in Central Polk and Hillsborough Counties, 1973 (Pedco 1976a)

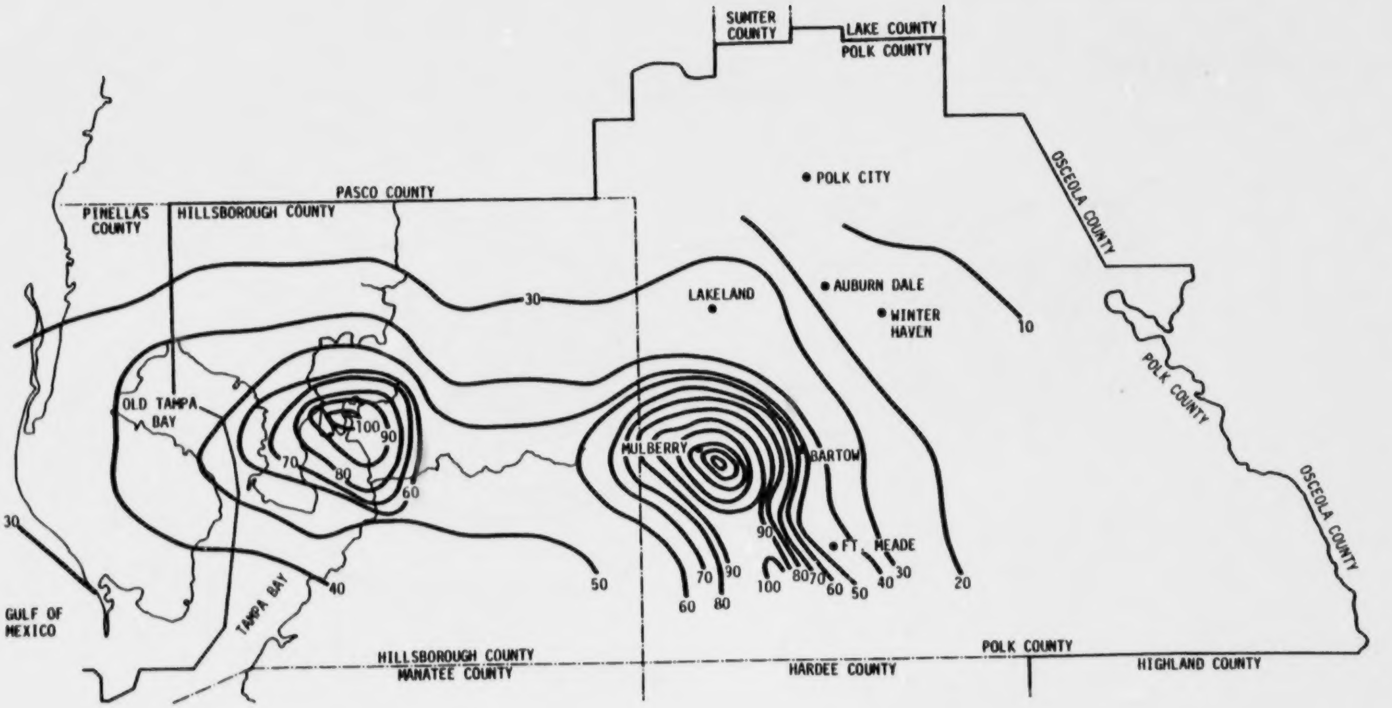
large areas in Polk and Hillsborough counties exceeding state and federal TSP standards.

Based on the emission summary of Table 2.17, some projections of 1976 particulate distribution can be made. Since the most effective air-pollution control devices were put into use in the study area after 1974, the distribution of dust in 1974 can be assumed to have been similar to the 1973 case modeled by Pedco. Furthermore, if the background levels of dust (ranging from 30 to 40 micrograms per cubic meter in Polk-Hillsborough counties) were associated with area source emissions that changed only slightly from 1974 to 1976, we may regard the excess (values over 40 micrograms per cubic meter) as having been caused by point sources and let them vary with the inventory in Table 2.17; thus, the maximum value in Polk County in 1973 (1974) was 200 micrograms per cubic meter, which means that 40 micrograms per cubic meter was attributed to area sources and 160 to point sources. Particulate emissions from point sources were reduced by 75 percent, which would have reduced the 200 micrograms per cubic meter isopleth to 80, the 175 to 74, the 150 to 68, and the 125 to 61.

For TSP data in this area, an arithmetic mean of 65 micrograms per cubic meter is approximately equal to a geometric mean of 60 micrograms per cubic meter (Pedco 1976a) and an arithmetic mean of 81 micrograms per cubic meter is equivalent to a geometric mean of 75 micrograms per cubic meter. Thus, with the federal standard of 75 micrograms per cubic meter (annual geometric mean) and the state standard of 60 micrograms per cubic meter (annual geometric mean), one would have expected only the state standard to have been exceeded over an extended area of Polk County in 1976 and neither to have been exceeded near Tampa. Area air quality data for one-half of 1976 confirm the location of the 1976 hot spots but indicate that both state and federal standards were still being exceeded. Considering the approximations and the possibility of local influences on individual sampling sites, only very small areas of Polk and Hillsborough counties can be expected to be over the air quality standards for TSP by the end of 1976. Because of the nature of the remaining sources of dust in Polk County and the Tampa area, it will be very difficult to remove the "hot spots" from the list of areas exceeding standards.

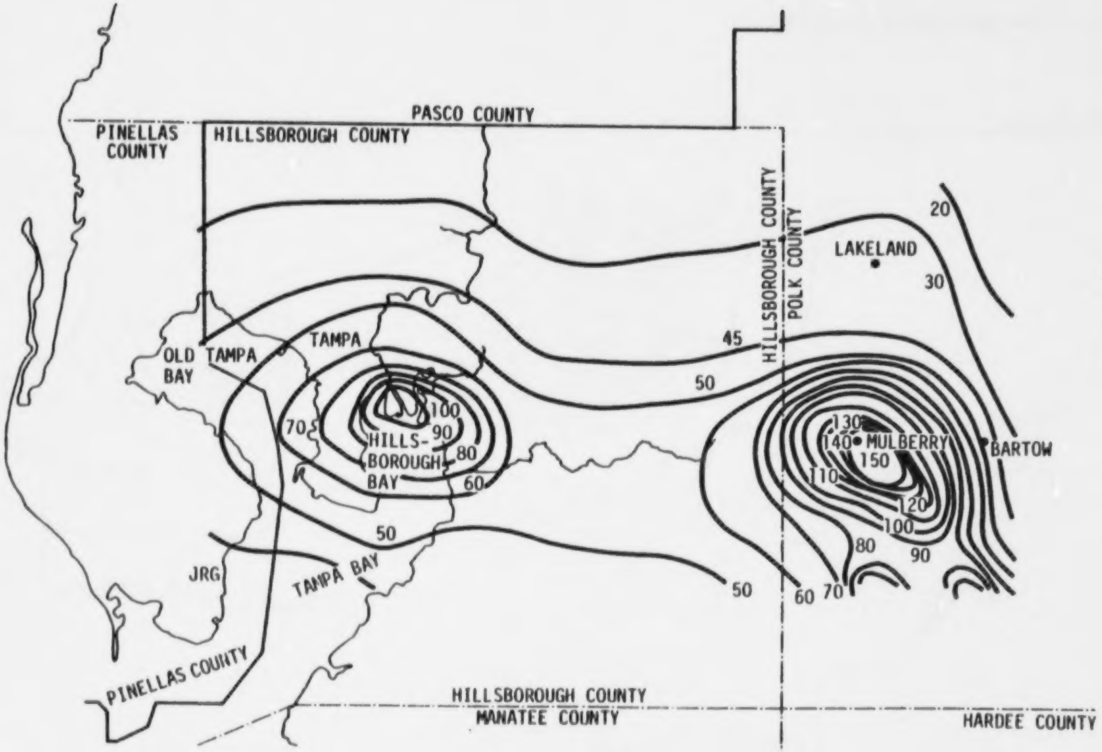
Calculated values of SO_2 concentrations in Polk and Hillsborough counties are presented in Figures 2.13 and 2.14, again under the assumption that 1974 showed similar distribution and similar values. Under the assumption similar to those for particulates, a background level assumed to be 10 micrograms per cubic meter (probably high), and reductions in each county according to point source reductions from 1974 through 1976 (Polk, 62 percent; Hillsborough, 11 percent), it was found that the highest level in Polk County was reduced from 150 micrograms per cubic meter to 63 micrograms per cubic meter and Hillsborough's high of 100 was reduced to 90 micrograms per cubic meter. These levels, if realized, would put Polk County almost into compliance with state and federal standards but would still leave a "hot spot" in Tampa. No reliable data for the Polk County area are available. The only continuous data on SO_2 ended in January 1976 but showed the 1975 levels of SO_2 in the Tampa "hot spot" area to be less than 60 micrograms per cubic meter (Pedco 1977). Extrapolations of the modeled SO_2 data to 1976 can be interpreted to give expected SO_2 distribution but, because of inadequate air quality data for comparison, are no bases on which to make accurate estimates of maximum ground-level concentrations. The probability that the calculated "hot spots" are the most likely places to exceed standards, however, is quite high.

An area not shown in the calculated distributions of SO_2 and particulates but which nevertheless is of interest because of major local sources is northern Manatee County. The Borden Piney Point plant and FP&L Parrish generating station are the major contributors to air pollution in the county and should be considered when projecting the phosphate industry's future impact on the study area. Unfortunately, present air quality data are not adequate to evaluate the impact of either source on the SO_2 levels in the county. TSP readings are confused by several dust sources that preclude complete isolation of the effects of either plant.


SUMTER COUNTY
LAKE COUNTY
POLK COUNTY
OSCEOLA COUNTY
POLK COUNTY
OSCEOLA COUNTY
PASCO COUNTY
PINELLAS COUNTY
HILLSBOROUGH COUNTY
POLK CITY
LAKELAND
AUBURN DALE
WINTER HAVEN
OLD TAMPA BAY
MULBERRY
BARTOW
FT. MEADE
TAMPA BAY
GULF OF MEXICO
HILLSBOROUGH COUNTY
MANATEE COUNTY
HARDEE COUNTY
POLK COUNTY
HIGHLAND COUNTY
10
20
30
40
50
60
70
80
90
100

Arithmetic mean in micrograms per cubic meter

Figure 2.13. Calculated SO_2 Concentrations in Polk and Hillsborough Counties, 1973 (Pedco 1976a)


PASCO COUNTY
PINELLAS COUNTY
HILLSBOROUGH COUNTY
HILLSBOROUGH COUNTY
POLK COUNTY
LAKELAND
20
30
45
50
OLD BAY
TAMPA
TAMPA
70
100
90
80
60
HILLS-BOROUGH BAY
50
JRG
TAMPA BAY
50
60
70
130
140
MULBERRY
150
BARTOW
110
120
100
80
90
PINELLAS COUNTY
HILLSBOROUGH COUNTY
MANATEE COUNTY
HARDEE COUNTY

Arithmetic mean in micrograms per cubic meter

Figure 2.14. Calculated SO_2 Concentrations in Central Polk and Hillsborough Counties, 1973 (Pedco 1976a)

SECTION 3

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APPENDIX 1

AIR QUALITY DATA SITE LIST BY ASCENDING SAROAD NUMBER

Air Quality Data Site List by Ascending SAROAD Number*

Site No.	Local Name	Responding Agency	UTM** North	UTM East	First Data	Parameters Tested***		
						TSP	SO_2	F
0080-001	Arcadia City Hall	DER-South	3010.6	414.7	4/73	X	X	-
0080-002	Arcadia Public Works	DER-South	3010.6	413.4	1/76	X	X	-
0180-001	Bartow DOT	DER-West	3086.5	416.8	11/73	X	X	-
0180-002	Bartow New	DER-West	3084.1	418.4	7/76	X	X	-
0320-002	MCPCD Lab/office	MCPCD	3041.9	340.0	7/66	X	X	X
0320-003	Parrish Rutland Rd.	MCPCD	3050.8	359.5	10/73	X	X	X
0320-004	Palmetto Police	MCPCD	3044.9	344.2	6/74	X	X	X
0320-005	SIP Trailer	MCPCD	3038.5	345.3	3/75	X	-	-
0320-006	Mills House Parrish	MCPCD	3053.0	366.0	5/76	-	X	-
0370-001	Brandon Water	HCEPC	3091.4	374.5	1/73	X	X	-
1800-003	Ruskin Fire Station	HCEPC	3066.8	385.8	1/72	X	X	-
1800-017	Keystone Park	HCEPC	3112.6	344.8	1/72	X	X	-
1800-018	Lutz School	HCEPC	3114.3	356.5	1/73	X	-	-
1800-019	Sun City	HCEPC	3066.3	368.3	1/73	X	-	-
1800-021	County BARN	HCEPC	3074.8	366.3	10/72	X	X	-
1800-022	Progress Village	HCEPC	3085.7	365.3	1/72	X	-	-
1800-040	Albert Miles Grove	DER-West	3083.0	394.5	5/71	-	X	X
1800-054	41 S., East of Gardinier	HCEPC	3082.7	363.8	7/73	-	X	-
1800-064	41 S. at 60 E.	HCEPC	3091.5	362.1	4/72	X	X	-
1800-065	Gibsonton	HCEPC	3081.9	364.1	7/72	-	X	-
1800-066	ICWU Bldg.	HCEPC	3086.1	362.1	4/72	X	X	-
1800-080	Special Study	HCEPC	3083.7	395.4	8/75	X	-	-
1865-001	Holmes Beach	MCPCD	3044.0	330.6	8/72	X	X	X
2160-001	Lakeland	DER-West	3107.5	407.5	12/73	X	X	-
2160-002	Scott Lake	DER-West	3094.0	406.5	1/75	X	X	X
2540-003	Whitfield Fire Station	MCPCD	3032.2	345.3	7/72	X	X	X
2540-004	Lake Manatee	MCPCD	3042.0	365.6	7/72	X	X	X
2540-005	County Line N.	MCPCD	3058.6	349.6	5/66	X	X	X
2540-008	Holland House	MCPCD	3056.2	348.1	5/66	X	X	X
2540-011	Socolof Fish Farm	MCPCD	3053.7	351.0	8/71	X	X	X
2540-012	Port Manatee	MCPCD	3057.6	346.0	9/71	X	X	X
2540-013	Reeders Dairy	MCPCD	3056.3	350.0	12/65	-	X	X
2860-001	Mulberry City Hall	DER-West	3085.7	404.2	4/73	X	X	-
3440-001	Palmetto Shell	MCPCD	3044.0	344.6	8/72	X	X	X
3660-001	Plant City	HCEPC	3099.7	389.7	1/72	X	-	-
3680-001	Union Hall	DER-West	3085.2	408.9	5/71	X	X	X
3680-002	Willard Rowe	DER-West	3071.0	416.9	5/71	X	X	X
3760-002	DER-South Lab/Office	DER-South	2977.5	400.2	3/73	X	X	-
4080-001	Court House	SCOPC	3024.9	351.0	7/73	X	-	-
4100-001	Longino	SCOPC	3005.8	392.8	7/73	X	X	X
4100-002	SCDEC Lab/Office	SCOPC	3022.7	356.4	4/74	X	X	X
4100-005	Myakka State Park	SCOPC	3013.4	370.0	4/73	-	X	-
4100-006	Sarasota Airport	SCOPC	3030.7	346.9	2/72	X	X	X
4360-001	315 E. Kennedy	HCEPC	3092.3	357.0	2/69	X	-	-
4360-002	1105 E. Kennedy	HCEPC	3092.3	356.3	2/72	X	X	-
4360-003	Bayside School	HCEPC	3091.4	359.0	1/72	-	X	-
4360-006	Tampa Airport	HCEPC	3095.1	350.2	1/72	X	-	-
4360-018	County BARN	HCEPC	3092.9	365.0	1/72	X	-	-
4360-020	301 E. 7th Ave.	HCEPC	3093.3	356.7	4/72	-	X	-
4360-021	906 Jackson	HCPEC	3092.2	357.1	1/73	X	X	-
4360-024	311 S. 22nd St.	HCEPC	3091.9	358.9	1/73	X	-	-
4360-030	Grady School	HCEPC	3090.0	351.6	2/72	X	X	-
4360-034	MacDill AFB	HCEPC	3079.5	355.0	1/72	X	X	-
4360-035	Davis Is. Coast Guard	HCEPC	3090.1	357.0	1/73	X	X	-
4440-001	Temple Terrace	HCEPC	3102.7	363.4	1/72	X	-	-
4880-001	Winter Haven	DER-West	3100.0	423.5	1/69	X	-	-

*Urone, P. and J. Chadbourne. 1977. Air quality data summary. TI.

**Universal transverse mercator.

***TSP, total suspended particulates; SO_2, sulfur dioxide; F, fluoride.

APPENDIX 2

24-HOUR SULFUR DIOXIDE DATA SUMMARY, 1972-76

24-Hour Sulfur Dioxide Data Summary, 1972-76* (Page 1 of 3)

County	Site No.	Year	No. Obs.	Micrograms per Cubic Meter						
				Arith Mean	Arith Dev	Geom - Mean	Geom Dev	Maxima		
								1st	2nd	Proj
Charlotte	3760-002	1973	10	0	--	--	--	0.2	0.1	--
		1976	7	0	--	--	--	0.0	--	--
DeSoto	0080-001	1973	13	0	--	--	--	0.0	--	--
		1974	15	0	--	--	--	0.6	0.0	--
		1975	14	5	5.7	4	2.05	20	10	33
	0080-002	1976	26	1	3.2	3	1.50	14	6	10
Hillsborough	0370-001	1972	44	5	6.2	4	2.12	25	24	36
		1973	54	12	13.6	7	2.69	68	60	128
		1974	62	10	14.1	6	2.53	102	34	92
		1975	57	3	1.7	3	1.40	13	8	8
		1976	31	3	1.2	3	1.37	8	5	8
	1800-003	1973	37	27	31.7	14	3.38	134	126	503
		1974	58	11	13.3	6	2.67	60	47	108
		1975	58	9	18.3	5	2.65	99	89	88
		1976	30	6	6.7	4	2.27	26	24	45
	1800-021	1976	25	12	11.6	8	2.38	55	26	102
	1800-040	1973	87	17	21.2	10	3.03	144	65	260
		1974	290	30	23.9	21	2.51	154	133	314
		1975	313	8	15.7	5	2.82	105	94	105
		1976	120	6	16.6	4	2.42	150	58	54
	1800-054	1973	26	26	18.8	18	2.58	71	68	292
		1974	54	26	43.1	11	3.58	264	144	468
		1975	56	14	12.9	9	2.72	58	45	171
		1976	28	20	19.1	12	2.89	94	39	272
	1800-064	1972	39	13	17.6	8	3.00	86	52	202
		1973	53	20	20.4	12	2.93	94	81	283
		1974	56	54	348.9	6	3.08	2618	34	164
		1975	61	5	5.5	4	1.91	34	21	27
		1976	26	4	2.0	3	1.56	8	8	11
	1800-065	1972	26	33	37.7	16	3.88	134	126	862
		1973	56	54	134.4	19	4.20	990	202	1292
		1974	49	24	32.6	11	3.71	147	144	519
		1975	55	10	17.4	5	2.74	86	84	97
		1976	21	19	26.9	9	3.36	102	86	317
	1800-066	1972	37	14	20.0	7	3.52	70	59	283
		1973	53	33	65.6	15	3.47	461	131	582
		1974	52	21	41.1	9	3.19	233	160	273
		1975	52	11	17.4	6	2.58	115	47	97
		1976	25	9	10.5	5	2.58	47	24	81
	4360-002	1972	37	14	16.2	8	2.54	73	66	124
		1975	44	45	53.3	22	3.71	254	215	1038
		1976	25	20	19.4	12	3.03	84	47	312
	4360-003	1972	44	23	35.1	10	3.90	176	121	547
	4360-020	1972	35	13	29.9	6	3.00	174	46	152
		1973	44	22	22.9	12	3.25	97	73	384
		1974	61	16	26.4	7	3.17	160	92	208
	4360-021	1973	100	34	49.3	17	3.28	351	270	559
		1974	112	22	25.3	12	3.15	136	128	350
		1975†	115	21	24.4	11	3.31	144	102	371
		1976†	48	18	19.3	11	3.02	92	58	284

*Data to mid-1976.

Sources: Chadbourne, J. 1977. Air quality data listing.
PED Co-Environmental Specialists, Inc. 1977. Summary of Florida ambient air quality monitoring data for 1972-1975. Fla. Sulfur Oxide Study, Inc.

†One month of data missing.

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County	Site No.	Year	No. Obs.	Micrograms per Cubic Meter						
				Arith Mean	Arith Dev	Geom Mean	Geom Dev	Maxima		
								1st	2nd	Proj
Hillsborough (Contd)	4360-024	1973	47	26	26.7	17	2.66	154	86	302
		1974	53	23	22.3	13	3.06	92	89	348
		1975	58	19	27.1	8	3.42	136	97	297
		1976	23	4	6.0	3	1.72	31	5	15
	4360-030	1972	33	16	27.8	7	3.61	114	88	305
		1973	51	20	20.2	13	2.67	86	81	233
		1974	61	23	26.6	11	3.63	102	92	487
		1975	42	22	27.5	11	3.29	131	81	365
		1976	25	14	19.0	7	3.24	73	55	222
	4360-034	1972	45	18	36.4	6	3.81	166	137	306
		1973	44	44	48.4	22	3.62	175	168	966
		1974	63	18	21.0	10	3.01	123	92	255
		1975	55	4	4.5	3	1.76	29	21	16
		1976	28	4	3.1	4	1.74	16	10	20
	4360-035	1973	42	42	48.3	19	4.07	173	168	1178
		1974	63	31	26.6	20	2.90	120	102	458
		1975	50	25	24.9	13	3.53	113.	86	530
		1976	26	7	5.7	5	2.01	29	16	39
Manatee	0320-003	1973	10	10	12.0	6	3.07	34	23	162
		1974	52	3	8.0	3	1.91	51	19	20
		1975	49	1	3.2	3	1.45	18	10	9
		1976	41	1	3.9	3	1.53	23	7	10
	0320-004	1974	21	5	6.7	4	2.22	22	18	42
		1975	49	3	4.8	3	1.80	20	15	17
		1976	38	3	8.4	3	1.78	49	17	16
	0320-006	1976	24	1	3.6	3	1.53	16	7	10
	1865-001	1972	23	13	17.0	7	3.06	62	43	188
		1973	45	8	12.0	5	2.58	55	43	81
		1974	52	5	6.7	4	2.12	30	27	36
		1975	46	3	4.8	4	1.84	22	14	24
		1976	15	1	1.2	2	1.00	4	2	2
	2540-003	1972	23	6	9.4	4	2.40	34	28	52
		1973	48	6	11.8	4	2.42	57	52	54
		1974	50	4	7.2	4	2.06	37	24	33
		1975	47	3	7.2	3	1.94	42	19	21
		1976	18	2	4.4	3	1.61	19	2	12
	2540-004	1972	15	11	26.7	4	3.37	88	63	142
		1973	42	5	9.3	4	2.22	43	36	42
		1974	49	3	5.0	4	1.92	17	15	27
		1975	42	2	3.6	3	1.60	15	14	12
		1976	33	2	3.3	3	1.56	15	8	11
	2540-005	1972	50	5	10.5	4	2.31	46	39	47
		1973	26	5	8.2	4	2.25	31	28	43
		1974	61	2	3.5	3	1.63	13	13	13
		1975	43	3	4.5	3	1.79	16	15	17
		1976	41	2	2.0	3	1.29	7	6	6
	2540-008	1972	51	6	13.3	4	2.55	59	56	63
		1973	45	15	36.3	5	3.42	200	119	186
		1974	47	6	7.5	5	2.33	24	24	60
		1975	49	4	5.6	4	2.01	22	19	31
		1976	39	2	3.6	3	1.61	14	14	12

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				Micrograms per Cubic Meter						
								Maxima		
County	Site No.	Year	No. Obs.	Arith Mean	Arith Dev	Geom Mean	Geom Dev	1st	2nd	Proj
Manatee (Contd)	2540-011	1972	24	13	22.4	6	3.22	99	54	187
		1973	50	8	12.2	5	2.59	64	33	82
		1974	48	4	5.3	4	2.01	19	19	31
		1975	47	3	4.2	3	1.76	19	11	16
		1976	36	2	2.4	3	1.38	8	7	8
	2540-012	1972	50	18	28.5	9	3.38	165	75	323
		1973	49	24	28.4	13	3.47	123	119	504
		1974	50	15	21.5	8	3.32	99	88	272
		1975	45	5	6.9	4	2.15	30	22	38
		1976	41	3	4.2	3	1.69	22	10	14
	2540-013	1972	50	8	12.7	5	2.58	69	48	81
		1973	41	11	16.1	7	2.76	73	69	138
		1974	50	5	5.1	4	2.02	21	16	32
		1975	51	4	5.3	4	1.90	28	17	26
		1976	33	2	2.2	3	1.35	8	6	7
	3440-001	1972	26	15	25.4	7	3.42	113	59	260
		1973	51	8	12.9	5	2.61	62	56	84
		1974	19	5	11.4	4	2.25	49	13	43
Polk	0180-001	1973	9	6	9.7	5	2.68	24	21	91
		1974	52	35	50.0	13	4.38	190	172	1000
		1975	39	6	13.4	4	2.58	67	37	65
		1976	27	5	8.7	4	2.37	33	22	51
	0180-002	1976	15	3	7.6	3	2.08	28	9	26
	2160-001	1973	6	7	11.3	5	2.97	27	15	123
		1974	47	38	41.6	21	3.42	190	188	780
		1975	47	12	27.0	5	3.23	99	96	157
		1976	43	6	8.8	5	2.42	32	27	67
	2160-002	1975	297	12	28.7	5	3.13	203	181	143
		1976	153	6	8.9	4	2.35	50	44	49
	2860-001	1973	39	29	24.4	18	3.31	92	82	608
		1974	42	49	41.8	35	2.47	161	156	500
		1975	50	7	13.3	4	2.49	63	57	58
		1976	44	18	66.7	6	3.25	444	41	192
	3680-001	1973	79	47	45.5	26	3.57	214	213	1096
		1974	313	60	50.3	41	2.72	364	231	777
		1975	155	12	33.5	5	3.10	267	211	139
		1976	179	11	18.2	6	2.97	154	77	147
	3680-002	1973	80	18	24.9	9	3.58	132	76	383
		1974	340	28	31.1	14	3.66	201	155	635
		1975	308	8	19.8	4	2.78	170	117	81
		1976	163	2	4.5	3	1.71	22	21	15
Sarasota	4100-001	1973	37	1	2.9	3	1.52	10	9	10
		1974	40	1	2.9	3	1.41	16	7	8
		1975	46	0	0.6	--	--	4	1	--
		1976	38	0	0.05	--	--	0.2	0.1	--
	4100-002	1974	9	0	0.1	--	--	0.4	0.2	--
		1975	31	2	9.1	3	1.80	50	9	17
		1976	35	2	3.9	3	1.62	18	11	12
	4100-005	1973	38	3	5.6	3	1.97	19	17	22
		1974	19	3	5.3	3	1.88	19	15	19
	4100-006	1973	43	5	8.7	4	2.17	40	36	39
		1974	51	1	4.3	3	1.63	22	17	13
		1975	48	1	2.6	3	1.34	17	5	7
		1976	33	1	1.7	3	1.25	8	5	6

APPENDIX 3

24-HOUR SUSPENDED PARTICULATE DATA SUMMARY, 1972-76

24-Hour Suspended Particulate Data Summary, 1972-76* (Page 1 of 4)

				Micrograms per Cubic Meter						
								Maxima		
County	Site No.	Year	No. Obs.	Arith Mean	Arith Dev	Geom Mean	Geom Dev	1st	2nd	Proj
Charlotte	3760-002	1973	20	24	11.6	21	2.02	46	42	166
		1974	49	32	9.6	30	1.36	57	54	74
		1975	50	29	11.8	27	1.53	60	57	94
		1976	39	29	11.9	26	1.50	55	52	86
DeSoto	0080-001	1973	13	45	15.0	43	1.35	84	61	104
		1974	15	46	15.9	44	1.41	74	67	121
		1975	14	59	31.1	52	1.66	139	84	231
	0080-002	1976	28	59	27.4	53	1.54	148	101	189
Hillsborough	0370-001	1973	58	50	30.4	45	1.59	214	120	176
		1974	63	48	16.8	46	1.39	103	84	121
		1975	59	48	16.0	45	1.42	93	92	126
		1976	29	45	14.2	43	1.37	88	67	108
	1800-003	1972	61	43	16.6	40	1.40	120	83	108
		1973	57	40	17.1	37	1.48	93	90	117
		1974	59	36	12.0	34	1.41	68	63	93
		1975	54	42	12.3	40	1.40	66	63	108
		1976	31	44	14.3	42	1.37	85	76	106
	1800-017	1972	61	35	10.5	34	1.37	57	54	86
		1973	59	33	11.1	31	1.39	72	56	82
		1974	58	28	8.3	27	1.33	54	51	62
		1975	55	35	11.7	33	1.40	76	58	89
		1976	23	38	14.7	36	1.46	80	64	110
	1800-018	1973	57	41	22.1	37	1.57	129	123	139
		1974	59	47	27.3	41	1.66	146	129	182
	1800-019	1973	61	32	14.5	29	1.53	87	68	101
		1974	58	42	22.7	37	1.64	128	102	158
		1975	58	36	12.0	33	1.44	60	58	96
		1976	29	35	11.3	33	1.41	61	53	91
	1800-021	1972	11	45	9.7	44	1.25	60	55	85
		1973	61	41	15.5	38	1.42	108	79	107
		1974	55	43	17.0	41	1.38	130	75	106
		1975	54	41	12.3	39	1.37	69	65	98
		1976	29	44	11.5	43	1.32	63	62	97
	1800-022	1972	56	46	17.6	43	1.43	115	90	123
		1973	53	41	18.6	38	1.43	136	93	109
		1974	61	46	16.6	43	1.42	115	96	121
		1975	59	39	12.3	37	1.39	70	65	97
		1976	30	44	11.6	42	1.33	66	64	97
	1800-064	1972	39	68	23.2	64	1.42	126	115	179
		1973	60	59	17.3	56	1.37	97	91	141
		1974	61	84	25.3	80	1.35	156	147	193
		1975	53	75	19.8	72	1.31	118	115	159
		1976	30	78	18.3	76	1.27	116	106	153
	1800-066	1972	38	60	29.5	55	1.50	171	147	181
		1973	59	45	22.7	41	1.55	123	110	149
		1974	55	48	22.2	45	1.44	157	116	131
		1975	49	45	12.5	43	1.34	74	69	102
		1976	24	48	14.8	45	1.41	77	73	124
	1800-080	1975	22	53	19.8	50	1.45	101	98	149
	3660-001	1972	61	56	19.9	53	1.44	118	100	155
		1973	60	53	19.1	49	1.42	113	104	137
		1974	61	56	23.3	51	1.52	121	119	175
		1975	59	53	18.8	49	1.46	91	87	149
		1976	29	52	15.6	49	1.40	80	73	132

*Data to mid-1976.

Sources: Chadbourne, J. 1977. Air quality data listing.

PED Co-Environmental Specialists, Inc. 1977. Summary of Florida ambient air quality monitoring data for 1972-1975. Fla. Sulfur Oxide Study, Inc.

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				Micrograms per Cubic Meter						
								Maxima		
County	Site No.	Year	No. Obs.	Arith Mean	Arith Dev	Geom Mean	Geom Dev	1st	2nd	Proj
Hillsborough (Contd)	4360-001	1972	17	76	25.2	71	1.44	115	114	207
		1973	3	79	21.7	77	1.30	104	68	167
	4360-002	1972	12	77	26.2	73	1.43	121	105	209
		1975	29	68	25.2	63	1.49	119	112	203
		1976	8	73	17.8	71	1.32	99	81	161
	4360-003	1972	57	74	30.9	69	1.47	215	131	214
	4360-006	1972	59	62	29.7	56	1.61	158	135	227
		1973	56	53	27.0	48	1.55	164	121	174
		1974	54	58	21.9	54	1.47	113	106	168
		1975	51	51	15.8	49	1.40	99	87	132
		1976	28	52	13.0	50	1.31	73	71	111
	4360-018	1972	58	85	53.9	69	1.95	290	254	492
		1973	59	77	41.5	69	1.59	285	160	270
		1974	55	92	49.1	82	1.61	277	232	333
		1975	59	67	23.9	63	1.46	129	111	192
		1976	29	72	25.0	66	1.56	115	107	244
	4360-021	1973	117	93	35.2	86	1.53	212	204	300
		1974	94	83	28.0	78	1.44	167	166	228
		1975	310	68	22.5	64	1.41	147	142	176
		1976	124	67	22.0	64	1.40	159	135	172
	4360-024	1973	47	73	32.8	68	1.42	253	120	191
		1974	58	82	24.4	78	1.44	153	139	228
		1975	57	70	19.9	68	1.31	122	117	150
		1976	28	77	21.7	75	1.32	149	103	170
	4360-030	1973	53	74	37.6	68	1.45	265	208	203
		1974	59	63	17.9	60	1.36	103	93	148
		1975	49	59	17.6	56	1.34	128	93	132
		1976	31	60	16.8	58	1.33	98	96	134
	4360-034	1972	58	60	25.5	56	1.43	191	106	160
		1973	51	52	27.4	46	1.58	167	142	177
		1974	60	47	23.1	43	1.55	161	105	156
		1975	54	40	11.8	37	1.59	61	60	145
		1976	23	45	13.5	43	1.37	72	66	108
	4360-035	1973	47	96	48.6	84	1.72	227	216	414
		1974	66	92	38.4	84	1.55	197	187	305
		1975	52	80	27.7	75	1.42	140	135	210
		1976	56	63	18.9	60	1.39	100	96	158
	4440-001	1972	59	53	27.3	49	1.46	218	101	149
		1973	61	39	13.1	37	1.41	74	71	102
		1974	57	42	13.1	40	1.39	75	70	105
		1975	59	40	10.7	39	1.32	64	61	88
		1976	30	41	10.5	40	1.30	64	62	87
Manatee	0320-002	1972	12	68	21.9	65	1.41	110	95	178
		1973	18	62	22.3	58	1.45	104	99	173
		1974	23	48	17.4	45	1.45	88	73	134
		1975	24	53	21.2	49	1.44	116	84	143
		1976	19	43	14.4	41	1.38	76	66	106
	0320-003	1974	25	35	13.9	32	1.50	70	54	105
		1975	26	31	18.4	28	1.62	97	66	116
		1976	24	28	11.3	25	1.49	61	44	81

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				Micrograms per Cubic Meter						
								Maxima		
County	Site No.	Year	No. Obs.	Arith Mean	Arith Dev	Geom Mean	Geom Dev	1st	2nd	Proj
Manatee (Contd)	0320-004	1974	12	45	13.3	43	1.36	69	59	106
		1975	27	44	15.9	42	1.41	91	68	115
		1976	24	34	12.1	32	1.44	51	51	93
	0320-005	1975	7	59	28.5	53	1.72	98	81	261
	1865-001	1972	12	41	12.7	39	1.36	67	53	96
		1973	22	47	15.9	45	1.41	78	69	124
		1974	26	52	18.1	50	1.38	109	82	129
		1975	26	39	14.9	36	1.46	76	67	110
		1976	10	40	14.3	38	1.39	73	53	100
	2540-003	1972	13	29	9.1	28	1.36	47	41	69
		1973	25	48	25.7	43	1.52	149	83	197
		1974	27	43	18.0	40	1.50	90	75	132
		1975	26	39	34.0	31	1.88	174	86	198
		1976	10	30	9.2	29	1.37	44	42	73
	2540-004	1972	7	29	13.3	28	1.45	58	30	83
		1973	23	36	14.2	34	1.42	70	65	95
		1974	25	35	15.9	31	1.67	68	60	140
		1975	19	35	13.9	32	1.49	66	54	103
		1976	19	38	30.3	31	1.87	132	92	195
	2540-005	1972	25	43	14.4	41	1.40	72	65	110
		1973	16	33	11.3	31	1.43	51	49	89
		1974	31	47	38.2	39	1.69	220	121	182
		1975	27	37	22.8	32	1.62	121	79	132
		1976	23	33	21.4	30	1.58	118	55	115
	2540-008	1972	27	41	19.1	38	1.51	107	68	128
		1973	25	39	14.5	36	1.48	67	64	114
		1974	27	50	26.3	43	1.77	124	94	230
		1975	23	39	19.5	35	1.57	85	81	132
		1976	22	40	21.8	35	1.68	94	82	161
	2540-011	1972	10	33	12.0	31	1.42	56	45	87
		1973	26	33	12.5	31	1.61	55	52	126
		1974	33	62	88.0	37	2.62	389	311	628
		1975	24	31	10.8	29	1.46	56	51	88
		1976	20	27	8.7	26	1.40	43	40	70
	2540-012	1972	19	151	132.2	127	1.68	659	292	584
		1973	24	112	117.1	87	1.90	624	182	575
		1974	25	74	36.9	67	1.58	205	120	257
		1975	28	72	31.6	67	1.48	184	123	212
		1976	22	86	43.0	77	1.59	190	179	301
	3440-001	1972	10	54	15.4	51	1.38	80	66	131
		1973	23	53	18.2	51	1.40	95	85	137
		1974	8	72	16.4	70	1.26	95	94	138
Polk	0180-001	1973	9	54	26.6	50	1.45	122	57	149
		1974	49	67	25.0	63	1.43	166	122	180
		1975	42	67	67.5	56	1.67	464	158	253
		1976	26	52	19.5	49	1.50	92	78	161
	0180-002	1976	15	40	13.6	38	1.43	62	59	109
	2160-001	1973	6	50	11.1	49	1.24	66	62	92
		1974	42	62	14.9	61	1.27	100	96	123
		1975	44	58	26.9	54	1.44	189	97	158
		1976	40	47	14.0	45	1.34	86	73	106

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				Micrograms per Cubic Meter						
			No.	Arith	Arith	Geom	Geom	Maxima		
County	Site No.	Year	Obs.	Mean	Dev.	Mean	Mean	1st	2nd	Proj
Polk (Contd)	2160-002	1975	36	55	27.9	49	1.58	155	112	188
		1976	28	42	17.0	38	1.52	78	75	130
	2860-001	1973	37	68	22.6	64	1.47	128	111	199
		1974	44	103	37.4	97	1.47	180	179	301
		1975	51	104	35.8	97	1.45	219	159	289
		1976	44	88	43.3	79	1.57	201	198	298
	3680-001	1973	9	116	77.1	97	1.85	265	203	592
		1974	42	88	38.2	81	1.57	200	170	305
		1975	28	73	25.4	70	1.39	143	118	184
		1976	37	60	30.0	54	1.58	162	111	207
	3680-002	1973	14	72	52.2	60	1.80	230	115	338
		1974	34	64	39.0	55	1.70	200	152	262
		1975	43	66	37.2	57	1.75	166	150	295
		1976	30	54	48.1	41	2.03	223	179	329
	4880-001	1972	19	46	23.6	40	1.84	100	83	240
Sarasota	4080-001	1973	21	49	17.9	47	1.42	84	82	132
		1974	47	52	15.7	50	1.32	114	81	113
		1975	46	49	14.5	47	1.34	87	77	111
		1976	38	46	14.7	44	1.39	87	76	116
	4100-001	1973	18	29	10.1	27	1.44	46	45	79
		1974	37	38	22.7	33	1.72	110	81	163
		1975	38	30	16.1	26	1.64	83	62	111
		1976	37	31	16.2	27	1.68	80	62	124
	4100-002	1974	14	57	15.9	55	1.30	99	72	119
		1975	31	51	78.0	32	2.23	388	243	338
		1976	34	50	25.8	44	1.61	126	110	178
	4100-005	1974	4	22	4.0	22	1.19	28	22	37
	4100-006	1974	27	73	29.7	67	1.56	128	122	248
		1975	46	80	46.2	71	1.56	297	172	262
		1976	37	57	23.9	53	1.53	117	105	185

APPENDIX 4

ESTIMATED POINT SOURCE EMISSIONS BY PLANT IN STUDY AREA

Estimated Point Source Emissions by Plant in Study Area*
(Page 1 of 3)

County	Plant	Year	UTM Coord (km)		Metric Tons/Year (Tons/Yr)					
			North	East	Particulates		SO$_2$		Fluorides	
Charlotte	Charlotte Asphalt[e]	1974-76	2979.3	399.8	25	(27)	27	(30)		
	Macasphalt[e]	1974-76	2988.9	387.9	4	(4)	13	(14)		
	Martin Concrete[e]	1974-76	2974.8	376.4	1	(1)				
	Port Charlotte Ready Mix[e]	1974-76	2988.1	385.2	1	(1)				
	St. Joseph Hospital[e]	1974-76	2985.6	391.3	2	(2)				
DeSoto	Myakka Processors[e]	1974-76	3010.3	409.9	2	(2)	15	(16)		
	Myakka Processors[e]	1974-76	3004.2	411.4	12	(13)	27	(30)		
	DeSoto Canning[e]	1974-76	3009.8	414.7	15	(17)	43	(47)		
Hardee	American Orange[e]	1974-76	3043.0	420.4	14	(16)	109	(120)		
	City of Wauchula Electric[e]	1974-76	3047.7[e]	419.8[e]	23	(25)	5	(5)		
Manatee	Aquatite Concrete[e]	1974-76	Unknown	--	1	(1)				
	Belcher Oil[e]	1974-76	3057.9	346.6	2	(2)	23	(25)		
	Borden Inc.	1974	3057.3	348.5	104	(114)[e]	628	(691)[e]	11	(12)[e]
	Borden Inc.	1976	3057.3	348.5	42	(46)[a,c]	1,674	(1,841)[a,c]	2	(2)[a,c]
	Colonial Stores[e]	1974-76	3037.0	343.7	1	(1)				
	Dependable Feed Services[e]	1974-76	Unknown	Unknown	15	(17)				
	FP&L - Manatee, Unit 1[e]	1976**	3054.7	367.3	276	(304)	3,801	(4,181)		
	General Asphalt[e]	1974-76	3038.3	348.0	1	(1)				
	Manatee Metals Terminals[e]	1974-76	Unknown		9	(10)				
	Manatee Terminals, Port Manatee[e]	1974-76	3057.6	347.1	8	(9)				
	National Portland Cement[e]	1974-76	3059.1	346.6	45	(50)				
	Rinker Materials[e]	1974-76	3045.4	345.3	1	(1)				
	Surfacing Products[e]	1974-76	3034.3	371.4	11	(12)	52	(57)		
	Tropicana Products[e]	1974-76	3040.1	346.8	164	(180)				
	Vanply[e]	1974-76	3057.9	346.4	5	(5)				
	W.S. Dickey[e]	1974-76	3058.3	348.4	33	(36)	44	(48)		
Sarasota	Arlen Shopping Center[e]	1974-76	3013.2	352.1	2	(2)	1	(1)		
	Humane Society[e]	1974-76	3026.8	349.5	1	(1)				
	Martin Concrete[e]	1974-76	3017.8	353.7	1	(1)				
	Martin Concrete[e]	1974-76	3026.3	348.8	1	(1)				
	Martin Concrete[e]	1974-76	2997.6	365.3	1	(1)				
	Memorial Hospital[e]	1974-76	3022.4	348.4	1	(1)				
	Warren Bros.[e]	1974-76	3028.4	348.2	108	(119)	174	(191)		
Polk	Alcoma Packing[f]	1974	3085.5	452.4	5	(6)	70	(77)		
	Alcoma Packing[f]	1976	3085.5	452.4	5	(6)	79	(87)		
	Citrus World[f]	1974	3087.3	441.0	64	(70)	245	(269)		
	Citrus World[f]	1976	3087.3	441.0	68	(75)	265	(291)		
	Lakeland Electric - Larsen[f]	1974	3102.7	409.3	84	(92)	3,024	(3,326)		
	Lakeland Electric - Larsen[f]	1976	3102.7	409.3	84	(92)	3,024	(3,326)		
	Lakeland Electric - Plant 3[f]	1974	3106.2	409.2	120	(132)	4,975	(5,472)		
	Lakeland Electric - Plant 3[f]	1976	3106.2	409.2	212	(233)	3,964	(4,360)		
	Brewster - Bradley	1974	3070.5	403.8	2,207	(2,428)[f]	605	(666)[f]		
	Brewster - Bradley	1976	3070.5	403.8	1,885	(2,073)[a,c,f]	154	(169)[a,c,f]		
	Redd Orange Concrete[f]	1974	3106.2	402.1	2	(2)	15	(16)		
	Redd Orange Concrete[f]	1976	3106.2	402.1	2	(2)	15	(17)		
	Owens-Illinois[f]	1974	3106.0	404.3	58	(64)	20	(22)		
	Owens-Illinois[f]	1976	3106.0	404.3	63	(69)	22	(24)		
	Eger Concrete[f]	1974-76	3103.6	420.5	5	(5)				
	C&M Products[f]	1974	3079.1	405.5	25	(28)	119	(131)		
	C&M Products[f]	1976	3079.1	405.5	27	(30)	127	(140)		
	D.S. Prosser[f]	1974	3094.0	413.0	122	(134)				
	D.S. Prosser[f]	1976	3094.0	413.0	131	(144)				
	Swift Chemical	1974	3074.5	411.2	904	(994)[f]	3,635	(3,998)[f]	2	(2)[f]
	Swift Chemical	1976	3074.5	411.2	96	(106)[a,c]	1,232	(1,355)[a,c,f]	1	(1)[a,c]
	Standard Sand & Silica[f]	1974	3118.2	441.5	169	(186)	45	(50)		
	Standard Sand & Silica[f]	1976	3118.2	441.5	181	(199)	48	(53)		
	Kraft Foods[f]	1974	3101.8	399.0	27	(30)				
	Kraft Foods[f]	1976	3101.8	399.0	29	(32)				
	Sun Coast Canning[f]	1974	3069.9	420.7	15	(17)				
	Sun Coast Canning[f]	1976	3069.9	420.7	16	(18)				
	Keen Fruit[f]	1974	3070.3	448.0	2	(2)	25	(27)		
	Keen Fruit[f]	1976	3070.3	448.0	2	(2)	26	(29)		
	Ben Hill Griffin[f]	1974	3068.3	447.8	65	(71)	119	(131)		
	Ben Hill Griffin[f]	1976	3068.3	447.8	70	(77)	128	(141)		
	Swift Agrichem - Winter Haven[f]	1974	3097.4	428.0	25	(28)				
	Swift Agrichem - Winter Haven[f]	1976	3097.4	428.0	28	(31)				
	Owens-Illinois[f]	1974	3102.8	423.4	5	(6)				
	Owens-Illinois[f]	1976	3102.8	423.4	6	(7)				
	Coca-Cola[f]	1974	3103.6	421.3	34	(37)				
	Coca-Cola[f]	1976	3103.6	421.3	36	(40)				
	Mid-Florida Asphalt[f]	1974	3114.7	411.3	137	(151)	1	(1)		
	Mid-Florida Asphalt[f]	1976	3114.7	411.3	142	(156)	1	(1)		
	Alcoa[f]	1974	3069.5	416.8	15	(17)				
	Alcoa[f]	1976	3069.5	416.8	17	(19)				
	IMC - Noralyn	1974	3086.9	403.0	385	(424)[a,c,d,f]	249	(274)[c,d,f]	1	(1)[a,c,d,f]
	IMC - Noralyn	1976	3086.9	403.0	227	(250)[f]	249	(274)[a,c,f]	3	(3)[f]
	Borden - Teneroc	1974	3108.7	414.0	960	(1,056)[f]	236	(260)[c,f]		
	Borden - Teneroc	1976	3108.7	414.0	378	(416)[a,f]	236	(260)[c,f]		
	Hunt Bros.[f]	1974	3083.0	445.3	5	(6)	20	(22)		
	Hunt Bros.[f]	1976	3083.0	445.3	6	(7)	23	(25)		
	IMC - Kingsford	1974	3075.5	398.3	1,769	(1,946)[f]	742	(816)[c,f]	1	(1)[f]
	IMC - Kingsford	1976	3075.5	398.3	920	(1,012)[a,f]	742	(816)[c,f]	1	(1)[f]
	Bartow Laundry[f]	1974	3085.6	417.8	1	(1)	9	(10)		
	Bartow Laundry[f]	1976	3085.6	417.8	1	(1)	10	(11)		
	Bartow Memorial Hospital[f]	1974-76	3086.0	418.2	1	(1)	4	(4)		
	Adams Packing[f]	1974	3104.0	421.3	13	(14)				
	Adams Packing[f]	1976	3104.0	421.3	14	(15)				
	Blue Seal Excavating[f]	1974	3092.8	405.2	10	(11)	32	(35)		
	Blue Seal Excavating[f]	1976	3092.8	405.2	10	(11)	33	(36)		
	Carpenter's Home[f]	1974-76	3108.8	405.0	1	(1)	27	(30)		
	W.G. Roe & Son[f]	1974-76	3097.6	427.9			5	(5)		

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County	Plant	Year	UTM Coord (km)		Metric Tons/Year (Tons/Yr)					
			North	East	Particulates		SO_2		Fluorides	
Polk (Contd)	Orlando Paving^{f}	1974	3125.0	443.0	51	(56)	17	(19)		
	Orlando Paving^{f}	1976	3125.0	443.0	53	(58)	18	(20)		
	Gardinier - Ft. Meade	1974	3063.5	415.5	419	(416)^{f}	664	(730)^{f}	6	(7)^{e}
	Gardinier - Ft. Meade	1976	3063.5	415.5	100	(110)^{e,f}	738	(812)^{c,e}	6	(7)^{e}
	Orange Co. of Fla.^{f}	1974	3083.6	418.7	7	(8)	59	(65)		
	Orange Co. of Fla.^{f}	1976	3083.6	418.7	8	(9)	64	(70)		
	W.R. Grace	1974	3085.8	409.5	1,040	(1,144)^{f}	13,923	(15,315)^{f}	35	(38)^{c}
	W.R. Grace	1976	3085.8	409.5	121	(133)^{c}	5,918	(6,510)^{c,e}	35	(38)^{c}
	Mobil Chem - Nichols	1974	3085.2	398.5	9,975	(10,972)^{f}	1,791	(1,970)^{f}	2	(2)^{e}
	Mobil Chem - Nichols	1976	3085.2	398.5	1,292	(1,421)^{c,f}	2,137	(2,351)^{c,e}	2	(2)^{e}
	Royster	1974	3085.2	406.7	259	(285)^{f}	2,820	(3,102)^{f}	12	(13)^{e}
	Royster	1976	3085.2	406.7	75	(82)^{e,f}	10,837	(11,921)^{c,e}	12	(13)^{e}
	USS Agrichem - Bartow	1974	3086.3	413.2	129	(142)^{f}	2,826	(3,109)^{f}	1	(1)^{c}
	USS Agrichem - Bartow	1976	3086.3	413.2	5	(5)^{e}	101	(111)^{c,e}		
	USS Agrichem - Ft. Meade	1974	3069.0	416.0	500	(550)^{f}	14,922	(16,414)^{f}	4	(4)^{e}
	USS Agrichem - Ft. Meade	1976	3069.0	416.0	51	(56)^{e}	1,067	(1,174)^{c,e}	4	(4)^{e}
	CF Chem - Bartow	1974	3083.0	409.0	175	(193)^{f}	33,495	(36,844)^{f}	26	(29)^{e}
	CF Chem - Bartow	1976	3083.0	409.0	92	(101)^{e,f}	4,285	(4,714)^{c,e}	26	(29)^{e}
	Farmland Industries	1974	3079.5	409.7	667	(734)^{f}	16,126	(17,739)^{f}	82	(90)^{c}
	Farmland Industries	1976	3079.5	409.7	668	(735)^{c}	4,285	(4,713)^{c,e}	82	(90)^{c}
	Agrico - Pierce	1974	3079.0	404.0	7,260	(7,986)^{f}	1,962	(2,158)^{f}		
	Agrico - Pierce	1976	3079.0	404.0	153	(168)^{e,c}	791	(870)^{c,e}		
	Agrico - S. Pierce	1974	3071.4	407.5	275	(302)^{f}	15,285	(16,813)^{f}	26	(29)^{c}
	Agrico - S. Pierce	1976	3071.4	407.5	5	(6)^{e}	1,069	(1,176)^{c,e}	26	(29)^{c}
	IMC - Prairie	1974	3087.2	402.8	90	(99)^{f}	235	(259)^{f}		
	IMC - Prairie	1976	3087.2	402.8	25	(28)^{e}	106	(117)^{c,e}		
	Conserv Chemical	1974	3084.2	398.4	103	(113)^{c}	281	(309)^{c}	3	(3)^{c}
	Conserv Chemical	1976	3084.2	398.4	105	(115)^{e,c}	301	(331)^{e,c}	3	(3)^{e,c}
	Electro-Phos	1974	3079.4	405.6	2,786	(3,065)^{f}	225	(247)^{f}	2	(2)^{e}
	Electro-Phos	1976	3079.4	405.6	245	(269)^{e}	211	(232)^{c,e}	2	(2)^{e}
	IMC - Bonnie	1974	3075.0	402.0	104	(114)^{e,c}	150	(165)^{c,e}	17	(19)^{e}
	IMC - Bonnie	1976	3075.0	402.0	104	(114)^{e,c}	150	(165)^{c,e}	17	(19)^{e}
	Westvaco^{e}	1976	3086.7	408.3	2	(2)	3	(3)		
	Sikes^{e}	1974-76	3102.2	405.2	8	(9)				
	Pavers^{e}	1974-76	Unknown		15	(17)				
	Mid-State Paving^{e}	1974-76	Unknown		17	(19)	9	(10)		
	Kaplan Industries^{e}	1974-76	3079.3	418.3	6	(7)				
	Kaiser Aluminum^{e}	1974-76	3086.5	401.5	1	(1)				
	Jacquins - Fla. Dist.^{e}	1976	3102.8	421.4	15	(17)	17	(19)		
	Holly Hill Fruit Prod.^{e}	1976	3115.4	410.0	40	(44)	21	(23)		
	Dunn Construction^{e}	1976	3102.7	399.0	20	(22)				
	Custom Chem^{e}	1974-76	3086.7	408.3	1	(1)	1	(1)		
	A-Z Products^{e}	1976	3098.9	410.7	2	(2)	2	(2)		
	IMC - New Wales^{e}	1976	3078.9	396.5	235	(259)	2,539	(2,793)	25	(27)
Hillsborough	Brewster Chemical Lonesome Mine	1974	3067.9	389.6		0 ^{a}		0 ^{a}		0 ^{a}
	Brewster Chemical Lonesome Mine	1976	3067.9	389.6	18	(20)$^{e\ c}$	104	(114)^{a,c}		
	CPI (CF Industries)	1974	3115.7	388.3	997	(1,097)^{a}	8,215	(9,037)^{a}	15	(16)^{e}
	CPI (CF Industries)	1976	3115.7	388.3	150	(165)$^{a\ e\ c}$	1,737	(1,911)$^{e\ c}$	15	(16)^{a,c}
	Jos. Schlitz Brewing	1974	3103.2	362.0	2	(2)^{a}	4	(4)^{a}		
	Jos. Schlitz Brewing	1976	3103.2	362.0	1	(1)^{e}	4	(4)^{e}		
	Gardinier	1974	3082.5	362.9	1,901	(2,091)^{a}	15,726	(17,299)^{a}	47	(52)^{e}
	Gardinier	1976	3082.5	362.9	1,601	(1,771)$^{a\ e}$	14,802	(16,282)^{e}	47	(52)^{e}
	Tampa Water Works	1974	3100.2	359.3	25	(28)^{a}	436	(480)^{a}		
	Tampa Water Works	1976	3100.2	359.3	11	(12)^{e}	129	(142)^{e}		
	Cone Bros., N. 12th St.	1974	3107.6	357.7	31	(34)^{a}	80	(88)^{a}		
	Cone Bros., N. 12th St.	1976	3107.6	357.7	32	(35)^{e}	22	(24)^{e}		
	Eastern Associated Terminals	1974	3089.0	360.2	614	(675)^{a}				
	Eastern Associated Terminals	1976	3089.0	360.2	104	(114)^{e}				
	Edgar Plastic Kaolin	1974	3098.0	385.0	11	(12)^{a}				
	Edgar Plastic Kaolin	1976	3098.0	385.0	7	(8)^{e}				
	W.T. Edwards Hospital^{a}	1974	3096.5	357.4	3	(3)	24	(26)		
	W.T. Edwards Hospital^{a}	1976	3096.5	357.4	3	(3)	12	(13)		
	General Portland	1974	3090.6	357.9	1,256	(1,382)^{a}	4,378	(4,816)^{a}		
	General Portland	1976	3090.6	357.9	112	(123)^{e}	5,706	(6,277)^{e}		
	Ralston Purina	1974	3093.2	360.3	136	(150)^{a}	40	(44)		
	Ralston Purina	1976	3093.2	360.3	4	(4)^{e}	7	(8)^{e}		
	Florida Steel	1974	3094.2	364.6	84	(92)^{a}				
	Florida Steel	1976	3094.2	364.6	74	(81)^{e}	9	(10)^{e}		
	IMC - Port Sutton	1974	3087.5	360.1	1,615	(1,776)^{a}	204	(224)^{c,e}		
	IMC - Port Sutton	1976	3087.5	360.1	188	(207)^{e}	204	(224)^{c,e}		
	Kaiser Agricultural	1974	3092.6	367.3	23	(25)^{a}	12	(13)^{a}		
	Kaiser Agricultural	1976	3092.6	367.3	13	(14)^{e}				
	Singleton Packing^{a}	1974	3093.3	362.4			6	(6)		
	Singleton Packing^{a}	1976	3093.3	362.4			3	(3)		
	Mineral Aggregates	1974	3075.0	371.5	10	(11)^{a}	6	(6)^{a}		
	Mineral Aggregates	1976	3075.0	371.5	1	(1)^{e}	6	(6)^{e}		
	National Gypsum	1974	3082.5	347.4	175	(193)^{a}	5	(5)^{a}		
	National Gypsum	1976	3082.5	347.4	85	(93)^{e}	8	(9)^{e}		
	Nitram	1974	3089.0	363.1	105	(116)^{a}	360	(396)^{a}		
	Nitram	1976	3089.0	363.1	89	(98)^{e}	211	(232)^{e}		
	Southland Frozen Foods	1974	3098.9	389.8	3	(3)^{a}	40	(44)^{a}		
	Southland Frozen Foods	1976	3098.9	389.8	1	(1)^{e}	6	(6)^{e}		
	Seaboard Coastline	1974	3089.0	361.0	367	(404)^{a}				
	Seaboard Coastline	1976	3089.0	361.0	193	(212)^{e}				
	Standard Oil	1974	3082.5	342.5	1	(1)^{a}	17	(19)^{a}		
	Standard Oil	1976	3082.5	342.5	1	(1)^{e}	13	(14)^{e}		
	Sugar Rose Canning	1974	3099.7	389.5	1	(1)^{a}	17	(19)^{a}		
	Sugar Rose Canning	1976	3099.7	389.5	1	(1)^{e}	8	(9)^{e}		
	Teco - Hookers Pt.	1974	3091.0	358.0	320	(352)^{a}	11,778	(12,956)^{a}		
	Teco - Hookers Pt.	1976	3091.0	358.0	381	(419)^{e}	4,093	(4,502)^{e}		
	Teco - Big Bend	1974	3075.7	361.4	8,921	(9,813)^{a}	100,836	(110,920)^{a}		
	Teco - Big Bend	1976	3075.7	361.4	1,935	(2,128)^{e}	153,259	(168,585)^{e}		

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County	Plant	Year	UTM Coord (km)		Metric Tons/Year (Tons/Yr)					
			North	East	Particulates		SO_2		Fluorides	
Hillsborough (Contd)	Teco - Gannon	1974	3087.5	360.0	10,828	(11,911)[a]	122,308	(134,429)[a]		
	Teco - Gannon	1976	3087.5	360.0	1,515	(1,667)[d]	55,866	(61,453)[d]		
	Tampa General Hospital	1974	3091.0	356.5	4	(4)[a]	39	(43)[a]		
	Tampa General Hospital	1976	3091.0	356.5	1	(1)[d]	13	(14)[d]		
	Tampa Municipal Incinerator	1974	3092.3	360.3	525	(577)[a]	360	(396)[a]		
	Tampa Municipal Incinerator	1976	3092.3	360.3	702	(772)[d]	210	(231)[d]		
	Robbins Manufacturing	1974	3105.4	357.6	45	(49)[f]				
	Robbins Manufacturing	1976	3105.4	357.6	17	(19)[d]				
	Thatcher Glass	1974	3102.2	360.4	97	(107)[a]	2	(2)[a]		
	Thatcher Glass	1976	3102.2	360.4	69	(76)[d]	160	(176)[d]		
	Wenczel Tile	1974	3084.5	349.7	3	(3)[a]	27	(30)[a]		
	Wenczel Tile	1976	3084.5	349.7	1	(1)[d]	1	(1)[d]		
	Detsco Terminals	1974	3092.9	358.0	15	(17)[a]				
	Detsco Terminals	1976	3092.9	358.0	25	(27)[d]				
	Selco	1974	3088.3	361.8	15	(16)[a]	861	(947)[a]		
	Selco	1976	3088.3	361.8	7	(8)[d]	641	(705)[d]		
	Concrete Products of Tampa	1974	3101.3	357.6			6	(7)[a]		
	Concrete Products of Tampa	1976	3101.3	357.6	2	(2)[d]	1	(1)[d]		
	GAF[a]	1974-76	3087.0	362.4	3	(3)				
	Gulf Coast Lead	1974	3093.8	363.9	9	(10)[a]	358	(394)[a]		
	Gulf Coast Lead	1976	3093.8	363.9	1	(1)[d]	103	(113)[d]		
	River Gulf Terminals[a]	1974	3089.0	357.8	10	(11)				
	River Gulf Terminals[a]	1976	3089.0	357.8	11	(12)				
	Southeastern Galvanizing	1974	3094.5	368.5	19	(21)[a]				
	Southeastern Galvanizing	1976	3094.5	368.5	1	(1)[d]	1	(1)[d]		
	Weyerhauser[a]	1974	3094.2	360.2			4	(4)		
	Weyerhauser[a]	1976	3094.2	360.2			2	(2)		
	Florida SIP	1974	3098.9	388.2	125	(137)[a]	45	(49)[a]		
	Florida SIP	1976	3098.9	388.2	9	(10)[d]	17	(19)[d]		
	Borden - Plant City	1974	3096.3	393.8	763	(839)[a]	1,029	(1,132)[c,e]	7	(8)[a,c]
	Borden - Plant City	1976	3096.3	393.8	292	(321)[a,d]	1,029	(1,132)[c,e]	7	(8)[a,c]
	Delta Asphalt	1974	3105.3	372.4	28	(31)[a]				
	Delta Asphalt	1976	3105.3	372.4	27	(30)[d]	21	(23)[d]		
	W.R. Grace Construction Products	1974	3093.0	360.2	27	(30)[a]				
	W.R. Grace Construction Products	1976	3093.0	360.2	1	(1)[d]				
	Contract Battery Manufacturing[a]	1974	3091.6	368.7	5	(5)				
	Contract Battery Manufacturing[a]	1976	3091.6	368.7	5	(6)				
	Texaco	1974	3092.0	358.5	4	(4)[a]	32	(35)[a]		
	Texaco	1976	3092.0	358.5	1	(1)[d]	4	(4)[d]		
	Sulfur Terminals	1974	3089.2	358.0	9	(10)[a]	144	(158)[a]		
	Sulfur Terminals	1976	3089.2	358.0	9	(10)[d]	49	(54)[d]		
	Amoco Oil	1974	3092.0	357.8	11	(12)[a]	142	(156)[a]		
	Amoco Oil	1976	3092.0	357.8	5	(6)[d]	55	(60)[d]		
	Veterans Administration Hospital	1974	3104.7	359.8	18	(20)[a]	29	(32)[a]		
	Veterans Administration Hospital	1976	3104.7	359.8	2	(2)[d]	2	(2)[d]		
	St. Josephs Hospital	1974	3095.9	353.3	7	(8)[a]				
	St. Josephs Hospital	1976	3095.9	353.3	4	(4)[d]	1	(1)[d]		
	Southeastern Wire Manufacturing	1974	3094.5	368.5	24	(26)[a]				
	Southeastern Wire Manufacturing	1976	3094.5	368.5	1	(1)[d]	1	(1)[d]		
	River Gulf Terminal[a]	1974	3089.0	357.9	15	(17)				
	River Gulf Terminal[a]	1976	3089.0	357.9	16	(18)				
	CF Industries, Tampa Terminal[c]	1974-76	3088.5	353.4	3	(3)				
	Agrico, Big Bend Terminal[c]	1974-76	3076.2	361.4	1	(1)				
	Tampa Pumping Station[g]	1974-76	3092.2	360.0	11	(12)	68	(75)		
	Superior Fertilizer & Chemicals[g]	1974-76	3093.3	361.3	2	(2)				
	Woolco[g]	1974-76	3097.3	351.8	1	(1)				
	Verlite[g]	1974-76	3098.1	363.0	13	(14)	1	(1)		
	University Comm. Hospital[g]	1974-76	3105.7	360.0	1	(1)				
	SI Lime[g]	1974-76	3084.7	362.9	1	(1)				
	Reynolds Aluminum Can[g]	1974-76	3097.5	362.7	1	(1)				
	Ideal Basic Industries[g]	1974-76	3087.3	359.5	2	(2)				
	Florida Iron & Metal[g]	1974-76	3093.8	360.4	2	(2)				
	David D. Joseph[g]	1974-76	3098(?)	365.0	20	(22)				
	Continental Can[g]	1974-76	3093.9	360.9	1	(1)				
	Chevron Asphalt[g]	1974-76	Unknown		3	(3)	42	(46)		
	Amcon Concrete[g]	1974-76	3090.2	358.4	1	(1)				
	Cast Metals[g]	1974-76	3094.6	368.6	8	(9)				
	Bayonet Concrete[g]	1974-76	3090.2	358.4	1	(1)				
	Gold Bond Building Products[g]	1974-76	3092(?)	358(?)	54	(59)				
	Globe Union[g]	1974-76	3102.6	359.9	6	(7)				
	Cone Bros. - Osborne Ave.	1974	3096.4	362.0	20	(22)[a]	40	(44)[a]		
	Cone Bros. - Osborne Ave.	1976	3096.4	362.0	41	(45)[d]	22	(24)[d]		

[a] Pedco (1976a).

[b] DER (1976).

[c] USEPA (1976).

[d] DER (1977).

[e] USEPA (1977).

[f] Pedco (1976b).

[g] Shaw (1977).

[h] Estimated.

[i] 3 months.

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APPENDIX 5

AREA SOURCE EMISSION ESTIMATES FOR SO_2 AND PARTICULATE EMISSIONS

APPENDIX 5

AREA SOURCE EMISSION ESTIMATES FOR SO_2 AND PARTICULATE EMISSIONS

This appendix describes the equation with which the emission estimates presented in Table 2.15 were calculated. The equations were developed to handle the units presented in the reference literature. The calculated emissions were later converted to the metric units shown in Table 2.15.

Unless specifically cited, all references to Pedco in this appendix refer to Pedco 1975 and 1976. Any data used in the equations that were not provided in the Pedco reports are indicated in Table 5.1 at the end of this appendix.

A. MOBILE SOURCE EMISSIONS

1. Highways

Pedco data concerning emissions in Hillsborough, Polk, and Duval counties in 1973 were related to gasoline sales (Pedco 1975). The following equations were developed:

$$\text{Particulates (T/yr)} = \frac{\text{gasoline sales (gal.)}}{10^6} \times 8.53$$

$$SO_2 \text{ (T/yr)} = \frac{\text{gasoline sales (gal.)}}{10^6} \times 2.70$$

The validity of the correlation is expressed in the following table:

County	SO_2 (T/yr)		Particulates (T/yr)	
	Pedco ('73)	Calc.	Pedco ('73)	Calc.
Polk	398	400	1262	1262
Hillsborough	932	932	2945	2945
Duval	762	763	2410	2411

Gasoline sales data provided by Thompson (1976) were extended from 1974 to 1976 at an annual rate of increase of 3 percent and used to evaluate the seven counties. The emissions thus generated for Polk and Hillsborough counties were lower than the Pedco values, because the gasoline sales reported by Thompson were lower than the values used by Pedco.

2. Aircraft

Pedco's breakdown of emissions permitted the Tampa International and Jacksonville International airports to be isolated; only the Sarasota-Bradenton airport was considered outside Polk and Hillsborough counties. For air traffic at all three of these airports, Thompson had 1975 data available by type (Thompson 1976). Air traffic types were broken down into four categories — air carrier, air taxi, military, and general aviation — and the number of takeoffs and landings of each type weighted (100, 50, 100, and 1, respectively) to indicate the relative amounts of pollutant generated by an operation in each category. The weighting factors were based on the Pedco emission factors (Pedco 1975). A weighted operations number (K) was generated by the following formula:

$$K = [(\text{No. of air carrier ops}) \times 100] + [(\text{No. of taxi ops}) \times 50] + [(\text{No. of military ops}) \times 100] + [(\text{No. of G.A. ops})]$$

Emissions were then estimated by the following formulas:

$$SO_2 \text{ (tons)} = \frac{K \times 10^{-3}}{174}$$

$$\text{Particulates (tons)} = \frac{K \times 10^{-3}}{110}$$

The following table compares the Pedco data (1975) with that calculated using the preceding equations:

Airport	Particulates (T/yr)		SO_2 (T/yr)	
	Pedco	Calc.	Pedco	Calc.
Tampa International	68.64	62.74	106.01	99.25
Jacksonville International	32.48	35.22	52.55	55.72

The 1975 emissions were extended to 1974 and 1976 by assuming a 5 percent annual growth rate during that period. Pedco emission data were used as the basis for Polk and Hillsborough counties, with calculated values for Sarasota-Bradenton attributed to Manatee County.

3. Vessels

Port Tampa emission data prepared by Pedco were extended to Port Manatee and Charlotte Harbor. Emissions were related to the tonnage handled by each port. The following equations were used, with the shipping tonnage obtained from Thompson (1976):

$$\text{Particulates (T/yr)} = \text{(tonnage)} \times 1.79 \times 10^{-6}$$

$$SO_2 \text{ (T/yr)} = \text{(tonnage)} \times 21.2 \times 10^{-6}$$

The level of activity in these ports was assumed to have been constant from 1974 through 1976.

4. Railroads

Pedco based its apportionment of emissions by railroad traffic on miles of railroad track in each county. According to county road maps, Manatee, Hardee, Sarasota, DeSoto, and Charlotte counties had less track than Pinellas County; due to that county's low level of emissions, emissions in the study-area counties just mentioned were assumed to have been the same as those in Pinellas County and unchanging from 1974 through 1976. Emissions in Hillsborough and Polk counties were based on Pedco data, using a 5 percent annual growth factor from 1974 to 1976.

5. Off-Highway

In reviewing Pedco's development of off-highway emissions, it was found that the emissions should be related to county population and tractor usage. Equations were developed based on Pedco emission estimates for 1973 relating the emissions to population and land area devoted to agricultural use (in lieu of tractor count). Population and land use data were obtained from Thompson (1976) and Roy F. Weston Inc. (1976). The following equations were formulated:

$$\text{Particulates (T/yr)} = \text{(population)} \times 14.88 \times 10^{-5} + \text{(agricultural acreage)} \times 2.3 \times 10^{-5}$$

$$SO_2 \text{ (T/yr)} = \text{(population)} \times 19.6 \times 10^{-5} + \text{(agricultural acreage)} \times 0.87 \times 10^{-5}$$

The following table compares Pedco data (1973) with emissions calculated with the preceding formulas:

County	Particulates (T/yr)		SO_2 (T/yr)	
	Pedco ('73)	Calc	Pedco ('73)	Calc
Polk	46	47	54	53
Hillsborough	88	88	110	109

Using 1973 as the base year, Pedco data were used for Polk and Hillsborough counties, the remainder of the base-year numbers were calculated, and all values were extended to 1974 using a 3 percent growth factor and to 1976 using 10 percent.

B. STATIONARY FUEL COMBUSTION

To simplify the estimation under this heading, all fuel types were combined and the combined emissions published by Pedco related to the county populations. The following equations were used to evaluate emissions in Manatee, Hardee, Sarasota, DeSoto, and Charlotte counties:

$$SO_2 \text{ (T/yr)} = \frac{\text{(population)} \times 10^{-3}}{1.09}$$

$$\text{Particulates (T/yr)} = \frac{\text{(population)} \times 10^{-3}}{2.22}$$

The following table compares Pedco emission estimates in 1973 with those calculated using the preceding formulas:

County	Particulates (T/yr)		SO_2 (T/yr)	
	Pedco ('73)	Calc	Pedco ('73)	Calc
Hillsborough	245	253	510	516
Polk	123	116	237	237

Emission data for Polk and Hillsborough counties in 1974 and 1976 were estimated using a linear extrapolation of the Pedco data for 1973 and 1975. The remaining counties were calculated as above from Thompson's population figures, which were extrapolated linearly to obtain 1976 population numbers (Thompson 1976).

C. BURNING

1. Incineration and Open Burning

The values reported by Pedco in this category were very low, as well as constant over the 1974-76 time frame. Values for Manatee, Hardee, Sarasota, DeSoto, and Charlotte counties were assumed to have been the same as those for Polk County.

2. Forest Fires and Agricultural Burning

Emission from this source type were correlated with the land area of each county using Thompson's values of county land area (Thompson 1976). Only particulate emissions were considered. The following formula was developed:

$$\text{Particulates (T/yr)} = \frac{\text{(area in acres)}}{662}$$

These emissions were assumed to have been constant from 1974 through 1976 and were based on 1975 data. The correlation between the preceding formula and Pedco data is as follows:

	Particulates (T/yr)	
County	Pedco ('75)	Calc
Polk	1876	1980
Hillsborough	1090	1027

D. OTHER SOURCES

1. Citrus Heating

Citrus heating in the study area varies somewhat, depending on its proximity to the Gulf Coast. Because of this, the Pedco data from Hillsborough and Pinellas counties were used to characterize coastal counties (Manatee and Sarasota) while Polk County data were used to characterize inland counties (Hardee, DeSoto, and Charlotte). Using citrus acreage from Thompson (1976), the following formulas were developed:

- Coastal Area

$$\text{Particulates (T/yr)} = \frac{\text{(citrus acreage)}}{816}$$

$$SO_2 \text{ (T/yr)} = \frac{\text{(citrus acreage)}}{5660}$$

- Inland Area

$$\text{Particulates (T/yr)} = \frac{\text{(citrus acreage)}}{372}$$

$$SO_2 \text{ (T/yr)} = \frac{\text{(citrus acreage)}}{1927}$$

The correlation between the Pedco emission data and the coastal formulas is as follows:

	Particulates (T/yr)		SO_2 (T/yr)	
County	Pedco ('75)	Calc	Pedco ('75)	Calc
Hillsborough	49.7	49.5	7.1	7.1
Pinellas	4.8	4.8	0.7	0.7

The inland formula, being calibrated at only one point (Polk County), will not be displayed since by definition it will reproduce Polk County data.

Emissions from citrus heating are assumed to have been constant from 1974 through 1976.

2. Fugitive Dust

Dust in this category is assumed to come from several sources, and these were included in Pedco's development. To simplify this estimate, emissions were related to the miles of unpaved road in each county (from county road maps) and the level to which each county is developed; the latter was determined from Weston's land use classifications for 1975 (Roy F. Weston Inc. 1976). The following formula was developed:

$$\text{Fugitive dust (T/yr)} = \frac{\text{(unpaved road miles)} \times 712}{\text{(\% of county undeveloped)} + 3.5}$$

This formula was developed using Pedco's 1973 emission data as well as its numbers for miles of unpaved road. The following table refers values calculated with the formula to Pedco's 1973 estimates:

County	Particulates (T/yr)	
	Pedco ('73)	Calc
Polk	6307	6300
Hillsborough	4178	4188

Pedco's 1975 fugitive dust values in Polk and Hillsborough counties were used for 1974 and 1976. The remaining counties were calculated using the formula.

3. Reentrained Road Dust from Paved Roads

This source was correlated with gasoline sales by county. The correlation was established using Pedco emission data and gasoline sales in Polk, Hillsborough, and Pinellas counties in 1973. Values tabulated in this report involved the same gasoline sales used for highway emissions (Thompson 1976). The following formula was developed:

$$\text{Particulates (T/yr)} = \frac{\text{(gasoline sales in gal.)}}{6.24 \times 10^4}$$

It is verified below:

County	Particulates (T/yr)	
	Pedco ('73)	Calc
Hillsborough	5536	5532
Pinellas	4061	4061
Polk	2358	2372

Table 5.1. Data Used To Estimate Area Source Emissions in Manatee, Hardee, Sarasota, DeSoto, and Charlotte Counties

			Counties							
Data Type	Year	Source	Charlotte	DeSoto	Hardee	Hillsborough	Manatee	Polk	Sarasota	Duval
Gasoline sales (gal. x 10^6)	1974	*	17.78	9.01	10.24	332.95	47.57	144.58	66.52	-
	1976	*	18.86	9.55	10.86	353.23	50.46	153.38	70.25	-
Aircraft operations (x 10^3)	1975	*				Tampa	Sara-Brad			Jacksonville
Air carrier			-	-	-	98.52	13.30	-	-	37.52
Air taxi			-	-	-	18.91	8.40	-	-	7.03
Gen aviation			-	-	-	78.31	117.60	-	-	40.26
Military			-	-	-	0.41	0.79	-	-	19.85
Shipping (T x 10^6)	1972-75	*	2.5	-	-	41.7	3.5	-	-	-
Railroad track (miles)	1973	Maps	48	51	43	-	46	-	34	-
Population (x 10^3)	1973	*	36.1	15.9	17.0	-	108.2	-	148.1	-
Agricultural land (acres x 10^3)	1975	**	39	186.1	172.1	-	158.8	-	47.0	-
Population (x 10^3)	1974	*	39.8	17.7	18.1	-	117.6	-	157.7	-
	1976	*	44.7	18.7	18.9	-	129.7	-	168.9	-
County area (acres x 10^4)	1975	*	53.25	41.66	40.32	-	50.24	-	39.68	-
Citrus acreage (x 10^3)	1975	*	6.55	35.78	44.96	-	15.43	-	1.45	-
Unpaved roads (miles)	1973	Maps	102	118	254	-	182	-	92	-
% undeveloped	1975	**	98	98	99	-	92	-	83	

*Thompson (1976).

**Roy F. Weston (1976).

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